

THE
PRINCIPLES AND PRACTICE
OF
AGRICULTURE,
&c. &c.



HARVEST

THE
PRINCIPLES ~~AND~~ PRACTICE
OF
AGRICULTURE,
SYSTEMATICALLY EXPLAINED;
IN TWO VOLUMES:

Being a Treatise compiled for the Fourth Edition of
The ENCYCLOPÆDIA BRITANNICA,

AND REVISED AND ENLARGED BY

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A
SYSTEM
OF
AGRICULTURE.

CULTURE OF PARTICULAR PLANTS—CONTINUED.

3. CARROT.

OF all roots, a carrot requires the deepest soil. It ought Culture of carrot. at least to be a foot deep, all equally good from top to bottom. If such a soil be not in the farm, it may be made artificially by trench-ploughing, which brings to the surface what never had any communication with the sun or air. When this new soil is sufficiently improved by a crop or two with dung, it is fit for bearing carrots. Beware of dunging the year when the carrots are sown; for with fresh dung they seldom escape rotten scabs.

The only soils proper for that root are a loam and a sandy soil.

The ground must be prepared by the deepest furrow that can be taken, the sooner after harvest the better; immediately upon the back of which, a ribbing ought to succeed, as directed for barley. At the end of March, or beginning of April, which is the time of sowing the seed, the ground must be smoothed with a rake. Sow

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the seed in drills, with intervals of a foot for hand-hoeing: which is no expensive operation where the crop is confined to an acre or two: but if the quantity of ground be greater, the intervals ought to be three feet, in order for horse-hoeing.

In flat ground without ridges, it may be proper to make parallel furrows with the plough, ten feet from each other, in order to carry off any redundant moisture.

**Example of
successful
culture.**

An account is given, in the *Annals of Agriculture*, of a very correct mode of cultivating carrots, practised by a gentleman near Kidderminster, in the county of Worcester. "In the month of March he chooses a very clean six or seven years ley. With a plough calculated for the purpose he ploughs off the turf to the depth of rather more than two inches, which, after the first bout, falls to the bottom of a deep furrow made by the second plough; the second plough succeeds the first in every particular furrow, and cuts the ground to the depth of 14 or 15 inches in the whole, that is, including the depth of the former furrow. He generally endeavours to sow his seed about the 21st or 23d of this same month (March), not caring to be more early, as the young plants are very liable to be destroyed by the frosts which sometimes occur early in the month of May. The sowing he conducts in this manner:—He first directs a strong and rather heavy harrow to be passed over the tillage; when this is fine, the seed is sown in the broad-cast manner. In order to distribute the seed, and to make it spread regularly in the casting, some quarts of dry sand are well mixed among it to fill the hand and keep it asunder. The precise quantity of sand is immaterial; he generally puts four quarts to a pound of the seed. This part of the process, however, is in a great degree

degree discretionary, the only objects being the regular distribution of the seed in the hopper and on the land. Culture of particular Plants. The seedsmen must be careful to choose a day for this part of his business when there is very little wind, or he will perform it very imperfectly. At all times he must be careful to return near enough to his former cast, the specific gravity of the seed not admitting of extensive casts, like heavy grain. About three feet, perhaps, may serve as a mean width." Five pounds of good seed are usually sown on every acre; "more is superfluous; for if strong healthy plants actually arise and proceed from half a pound of the seed, the crop will be thick enough; and if two pounds of good seed do not produce plants in sufficient number, four pounds will not, and the deficiency ought to be attributed to the season. Good sound seed may be known by rubbing it in the hand; if it be sound, and have retained its virtues, by this treatment it will yield a strong, aromatic, volatile oil, very pungent to the smell. But the particular sort of carrot cannot be known by the seed; it can only be ascertained by a careful inspection of the roots themselves: a deep orange colour, fine clear and smooth skin, and single direct root, are qualities which distinguish the best. The seed should be harrowed in with a light harrow, and the soil left very fine. In about seven, or perhaps it may be eight, weeks, the young plants will appear. If the organization and secretion in the plant be, and remain perfect to the point of the leaf, it is a pretty certain indication that the plant will thrive and prosper; but if there be any discoloration of that part, it is a symptom that it will ultimately become abortive. When the plants have arisen to the height of about two inches, they should be perfectly cleared from weeds by

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the hand ; and if they grow not more than six inches from each other, the crop will be sufficiently thick." If they be nearer on an excellent soil, they ought to be reduced. " When they are strong enough to stand against the hoe, they should be well cleaned from weeds by this instrument ; in doing which it will not be necessary to attend to the moulding up of the plants, but the best managers have the weeds well cleared away by the hand afterwards. If there be occasion, the hoeing and cleansing should be repeated. Generally speaking, the crop will pay for every attention of this kind."

Flanders
mode of
culture.

In his Agricultural Tour into France Mr Young observed in French Flanders a singular mode of cultivating carrots. " They sow the seed at the same time, and on the same land, as flax, about Easter ; that crop is pulled in July, the carrots then grow well, and the produce more profitable than any other application of the flax stubble. They yield, I guess, from 60 to 80 bushels, and some more, per English acre ; but what I saw were much too thick."

From Argentau to Bailleul the same traveller saw " carrots taken up and guarded, by building, in the neatest and most effectual way against the frost : they are topped, laid in round heaps, and packed close with their heads outwards ; and being covered with straw in the form of a pyramid, a trench is digged around, and the earth piled neatly over the straw to keep out the frost. In this manner they are found perfectly secure."

At Parlington in Yorkshire, from the end of September to the first of May, 20 work-horses, four bullocks, and six milch cows, were fed on the carrots that grew on three acres ; and these animals never tasted any other food but a little hay. The milk was excellent : and,

over and above, 30 hogs were fattened upon what was left by the other beasts. We have this fact from undoubted authority.

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Carrots have been greatly recommended as food for cattle, and, in this respect, bid fair to rival the potato; though, with regard to the human species, they are far inferior. The profit attending the cultivation of them, however, appears to be much more doubtful than that of potatoes. Mr Arthur Young informs us *, that from *Norden's Surveyor's Dialogue*, published in 1600, it appears, that carrots were commonly cultivated at that time about Orford in Suffolk, and Norwich in Norfolk; and he remarks, that the tract of land between Orford, Woodbridge, and Saxmundum, has probably more carrots in it than all the rest of the kingdom put together." In 1779, few farmers in these parts had less than five or six acres; many from 10 to 20; and one had 36 acres: the straight, handsome, and clean roots were sent at 6d. per bushel to London; the rest being used at home, principally as food for horses. In other counties, he observes, the culture of carrots had not extended itself; that some had begun to cultivate them in place of turnips, but had soon desisted; so that the culture seemed in a manner still confined to the angle of Suffolk, where it first began. In attempting to investigate the cause of this general neglect, he observes, that "the charge of cultivation is not so great as is commonly imagined, when managed with an eye to an extensive culture, and not a confined one for one or two particular objects." Two acres which our author had

Much cultivated in Suffolk and part of Norfolk.

Why the culture has not extended itself.

* *Bath Papers*, vol. ii. p. 1.

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in carrots cost 3l. 17s. 6d. per acre, including every expence; but had not the summer been dry, he observes, that his expences might have been much higher; and when he tried the experiment 15 years before, his expences, through inadvertence, ran much higher. His difficulty this year arose chiefly from the *polygonum aviculare*, the predominant weed, which is so tough that scarcely any hoe can cut it. Some acres of turnips which he cultivated along with the carrots were all eaten by the fly; but had they succeeded, the expence of the crop would have been 18s. 5d. less per acre than the carrots. "But (adds our author) if we call the superiority of expence 20s. an acre, I believe we shall be very near the truth: and it must at once be apparent that the expence of 20s. per acre cannot be the cause of the culture spreading so little; for, to answer this expence, there are favourable circumstances, which must not be forgotten. 1. They (the carrots) are much more impenetrable to frost, which frequently destroys turnips. 2. They are not subject to the distempers and accidents which frequently affect turnips; and they are sown at a season when they cannot be affected by drought, which frequently also destroys turnips. 3. They last to April, when stock, and especially sheep farmers are so distressed, that they know not what resource to provide. 4. The culture requisite for turnips on a sandy soil, in order to destroy the weeds, destroys also its tenacity, so that the crop cannot thrive; but with carrots the case is otherwise. Hence it appears, that the reason why the cultivation of carrots is still so limited, does not arise from the expence, but because the value is not ascertained. In places where these roots can be sent to London, or sold at a good price, the tops

Superiority
of carrots
to turnips.

Difficulty
of ascer-
taining the
value

tops being used as food for cattle, there is not the least doubt that they are profitable; and therefore in such places they are generally cultivated: but from the experiments as yet laid before the public, a satisfactory decisive knowledge of the value is not to be gained. The most considerable practice, and the only one of common farmers upon a large scale, is that of the sands of Woodbridge; but here they have the benefit of a London market, as already mentioned. Amongst those whose experiments are published, Mr Billingsley ranks foremost. Here again the value of carrots is rather depreciated than advanced; for he raised great crops, and had repeated experience upon a large scale of their excellence in fattening oxen and sheep; feeding cows, horses, and hogs; and keeping ewes and lambs in a very superior manner, late in the spring, after turnips were gone: but notwithstanding these great advantages, he gave the culture up; from which we may conclude a deficiency in value. "In several experiments (though not altogether determinate), I found the value, upon an average of all applications, to be 13d. a bushel, heaped measure; estimating which at 70lb. weight, the ton is 11. 14s." The following are the valuations of several gentlemen of the value of carrots in the way of fattening cattle:

		<i>per ton.</i>
Mr Mellish of Blyth, a general valuation of		
horses, cows, and hogs,	-	L. 1 0
Mr Stovin of Doncaster, hogs bought lean,		
fatted, and sold off,	-	4 0
Mr Moody of Ratford, oxen fatted, and the		
account accurate,	-	1 0 0
	A 4	Mr

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per ton.

Mr Taylor of Bifrons, saving of hay and	
corn in feeding horses, - -	1 0 0
Mr Le Grand of Ash, fattening wethers,	0 13 9
Sir John Hobby Mill of Bisham, fattening	
hogs, - - - -	1 6 0
Mr Billingsley, for fattening hogs, -	1 13 6

Some other gentlemen whom our author consulted, could not make their carrots worth any thing : so that, on the whole, it appeared to him a matter of the utmost doubt, so contradictory are the accounts, whether the culture of carrots be really attended with any profit or not. Thus Sir John Mill, by fattening hogs, makes 11. 6s. and Mr Stovin 4l. ; but others could not fatten hogs upon them at all : and some of Mr Young's neighbours told him, that carrots were good for nothing except to *scour* hogs to death. The experiment of Mr Le Grand upon wethers appeared to be made with the greatest accuracy ; yet two circumstances seem to militate against it. 1. The sheep were put lean to them ; whereas it is a fact well known, that if they are not half fat when put to turnips, no profit will result ; and it is possible that the case may be the same with carrots. 2. He gave them also as much fine hay as they would eat.

New experiments recommended.

In this uncertain state of the matter, the only thing that this author could advise was, to make a number of experiments with as much accuracy as possible, in order to ascertain the real value per ton : and he endeavours to show, that there is no danger of losing much by experiments of this kind. " I have shown (says he), that they are to be cultivated for 4l. per acre, left on the ground for sheep. Suppose the crop only two bushels

at

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at 70lb. each per rood, 320 per acre, or ten tons; it will readily be agreed that such a produce is very low to calculate upon, since 20 tons are common among carrot-cultivators. It appears from Mr Le Grand's experiments, that a wether worth 2l. 5s. eats 16lb. of carrots, and four pounds of hay per day: dropping the hay, and calculating for sheep of less than half that size (which are much more common), it will be perhaps an ample allowance to assign them 12lb. of carrots a day. If they are, as they ought to be, half fat when put up, they will be completely fattened in 100 days. At this rate, 20 wethers will, in 100 days, eat 11 tons, or very little more than one moderate acre. Now, let it be remembered, that it is a good acre of turnips which will fatten eight such wethers, the common Norfolk calculation: from which it appears, that one acre of carrots is, for this purpose, of more value than two of turnips. Further, let us suppose horses fed with them instead of oats: to top, cart, and pack up, 10 tons of carrots, I know may be done for 20s.—An acre therefore (other expences included) costs 5l. Fifty pounds weight of carrots are an ample allowance for a horse a day: ten tons, at that rate, last three horses for five months. But this 5l. laid out in oats at 16s. per quarter, will purchase little more than six quarters; which will last three horses, at two bushels each per week, no more than two months; a most enormous inferiority to the carrots."

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In the same volume, p. 187. Mr Young gives an account of another experiment made by himself on the feeding of lambs with carrots. The quantities they ate varied excessively at different times; thirty-six of them consumed from five to ten bushels per day; but on an average,

Experiment
on feeding
lambs with
them.

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average, he rates them at four bushels of 56 pounds per day. In all, they consumed 407 bushels from November to April, when they were sold and killed fat. At putting upon the carrots, the lambs were valued only at 18l. but were sold in April at 25l. 4s.; so that the value of the carrots was exactly 7l. 4s. or about 4d. per bushel. This price he supposes to be sufficient to induce any one to attempt the culture of carrots, as thus he would have a clear profit of 40s. per acre; "which (says he) is greater than can attend the best wheat crops in this kingdom." The land on which the carrots grew was sown next year with barley, and produced the cleanest in the parish; which contradicts an assertion our author had heard, that carrots make land foul. The grass upon which the sheep were fed with the carrots, and which amounted to about an acre, was very little improved for the crop of hay in 1781, owing to the dryness of the season; but in 1782 was greatly superior to the rest of the field, and more improved in quantity: "for, instead of an indifferent vegetation, scattered thick with the *centaurea scabiosa*, *filago*, *rhinanthus*, *crista galli* and *linum catharticum*, with other plants of little value, it encouraged a very beautiful sheet of the best plants that can appear in a meadow, viz. the *lathyrus pratensis*, *achillea millefolium*, *trifolium repens*, *trifolium ochroleucum*, *trifolium alpestre*, and the *plantago lanceolata*.

Carrots
compared
with cab-
bages.

In the same volume of the Bath papers, p. 227, Mr Billingsley gives an account of the comparative profit of carrots and cabbages. Of the former, however, he obtained only seven tons 15 cwt. per acre; the cabbages produced 26 tons: nevertheless, according to him, the profit of the former was 5l. 8s.; of the latter, only

31. 118. In a paper on the culture of carrots by Mr Kirby of Ipswich, vol. iii. p. 84. he informs us, that he ~~never~~ determined the weight of an acre, but reckons the produce from 200 to 500 bushels; which, at 56lb. to the bushel, is from five to ten tons and a half. In the same volume, p. 320, the Rev. Mr Onley seems to prefer the culture of carrots to potatoes. “How-
ever valuable (says he), from ease of culture, and great-
ness of produce to the poor, especially in all small spots,
I doubt, unless near great towns, whether on a farm-
ing plan, potatoes be so eligible as other herbage or
roots, especially as carrots, which I cannot but *surmise*
(for my trials are too trivial to venture bolder language),
deserve every encouragement, even on soils hitherto
thought too heavy for them.—I am from experience
convinced, that an acre of carrots will double in the
quantum, of equally hearty provender, the product of
an acre of oats; and from the nature of their vegetation,
the nice mode of cultivation, and even of taking them
up (all of which, expensive as they are, bear a very in-
ferior proportion to the value of a medium crop), must
leave the land, especially if taken off it in an early pe-
riod, so mellow for the plough, as to form a seed-bed
for barley equal to any fallow-tith.”

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Culture of
carrots pre-
ferred to
potatoes.

Mr. Onley's desideratum was a substitute for oats to feed horses; of which great numbers are kept in his county (Essex). Potatoes, he observes, are excellent for *small* pork, when baked or boiled, mixed with a little barley meal; but for large hogs, they are most profitably given raw, if these have at the same time the shack of the barn door in thrashing season, &c. In the 5th volume he resumes the subject, and acquaints us, that he applied a single acre in his bean field to the
culture

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Superior to
turnips and
oats.

culture of carrots, which generally produced 400 bushels; and this he considers as a small produce. "I am, however, sensible (says he) that they will amply repay every expence of the finest culture; and should, from their extensive utility on sound, deep, and friable land, be everywhere attempted. Some of my neighbours, who have been induced to try them on rather a larger scale, with finer culture, and fresher soil, have raised from 600 to 900 bushels per acre, and applied them more profitably, as well as more generally, than any other winter herbage, to deer, sheep, bullocks, cows, and horses. At the lowest calculation, from our little trials, they are computed to exceed turnips in value one-third, as to quantity of food; but are far superior in what arises from convenience for the stable; where, to us, they seem to be a substitute for corn to all horses, at least such as are not used in any quick work; and particularly so with corn for those that are."

In making a comparison betwixt the profit on oats and carrots, Mr Onley found the latter exceed by no less than 2l. 15s. 8d. per acre. His method of cultivation is to sow them in March or April; to hoe them three times, harrowing after each hoeing. Sometimes he left them in the ground till after Christmas, taking them up as wanted, but afterwards he took them up in October, in dry days, putting them directly into small upright cocks of 10 bushels each, covered entirely, with the tops cut off.—Thus they appear to dry better than in any other way, and bear the weather with very little loss. If, after being thus dried, they are carried into any barn or shed, it will be better, if they are in large quantities, not to pack them close, on account of the danger of heating, but rather to throw them promiscuously

promiscuously into heaps, with a little straw over them. When perfectly dry, they do not in general require any washing, except for horses regularly kept in the stable. Culture of particular Plants.

This root has been found so generally valuable as a substitute for grain in feeding horses, that its use in that way is rapidly spreading into various parts of the country. By the quantity of saccharine matter which it contains, it is probably rendered extremely rich and stimulating to the stomach of that delicate animal, so that a less quantity of it goes to waste than of any other food. We may remark, that the gentleman already mentioned, Mr Onley, who had the merit of pressing upon the public attention the importance and utility of this root, mentions an use to which we believe it is not unfrequently applied in the dairy*. "In our dairies (says he) as many carrots are bruised before churning, as produce, squeezed through a cloth into as much cream as make eight or ten pounds of butter, an half pint of juice; this adds somewhat to the colour, richness, and flavour of winter butter; and we think, where hay is allowed besides, contributes much to counteracting the flavour from the feed of turnips. At present (our carrot feed being exhausted) from turnips and hay, with this juice, our butter is equal to that of the Epping dairies." Carrots now more generally used. Carrots used to colour butter.

An experiment that has been made of the possibility of cutting the tops of carrots to be used as green food for cattle, without injury to the roots, is too important and curious to be passed here unnoticed. It is stated in a letter Carrot-tops used as green food.

* *Annals of Agriculture*, vol. xii.

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ter from Henry Vavasour, Esq. to the editor of the *Annals of Agriculture* *. "Last spring I sowed, broad-cast, two acres of carrots following a potato crop on a light sandy loam of twenty shillings an acre. They were twice hoed at thirteen shillings the two, in the manner of hoeing turnips; and in the course of summer I mowed one third of the tops twice: another third of the tops I mowed once; and the remaining third of the crop the scythe did not pass over. The tops were greedily devoured by my horses, cattle, and pigs, in the fold-yard: and were equal in quantity and value to a considerable crop of clover cut and made use of in the same mode.

"At the end of October I took up the carrot-roots, and preserved them in a trench in the manner of potatoes. The crop was full six hundred bushels per acre; and it was not found that the roots of those carrots, whose tops had been twice cut, were at all inferior in size or quality to those whose tops had been left untouched. A passage was left for a small cart to carry off the tops, and another I made by drawing the young carrots wanted for family use.

"I have reason to consider this mode of cultivating carrots equal to the best fallow crop, provided the carrots are twice well hoed, and the tops are cut off, as the scythe prevents any weeds seeding in the autumn.

"My horses, oxen, milch-cows, and pigs, are at this time eating the carrot-roots; my turkies and other poultry have them boiled, and are fatted well upon them; even my pigeons are fed upon carrots, as they constantly

Poultry fed
with car-
rots.

ly attend in the fold-yard to pick up every particle that drops from the mouths of the cattle; which supply is sufficient to keep my pigeons at home, and to save an expence in feeding them during the severe weather.

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“ The market price for carrots, near my house, twelve miles east of York, is from ten pence to one shilling per bushel: at which price it must be allowed that the crop is a profitable one.

“ I must observe, that the demand for carrots in this neighbourhood is become not inconsiderable for stallions; for it is found, that this food is more invigorating and fattening than any other that can be given to them.”

We may conclude by taking notice here of an advantageous mode of cultivating carrots by making use of them with a view to stir the ground in young plantations. It was adopted by Thomas Walford, Esq. of Birdbrooke, Essex, who gives the following account of it:—“ It has been my constant practice for these last five years, wherever I made a plantation of firs, or deciduous trees, to sow the ground in the spring with carrots, which I have found not only to pay part of my expences, and frequently the whole, but to be much more beneficial to the trees than any other method I had before adopted.

Carrots advantageously cultivated in young plantations.

“ When I make a plantation of deciduous trees, the ground is dug two spits deep in October, and planted immediately, leaving it in that state until the middle or latter end of March, or beginning of April; then, if necessary, I chop it over with a hoe, and sow my carrots: if for firs, I do not dig the ground until March, at which time I plant my trees, and sow the carrots, having found

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my crop more luxuriant and productive upon ground fresh dug than that which was dug in the autumn.— I give for digging 8d. per rod; hoe only twice; the produce is generally four bushels of clean carrots, which I sell at 6d. per bushel, the buyer to fetch them from their place of growth.

“The soil in some places, loose and hollow; the under stratum clay; in others a fine vegetable mould upon a red loam.

“I find in taking up the carrots, less damage is done to the young fibres of the trees, than by digging between them; for, it is impossible, with the greatest care of your servants, not to cut off some of them by digging, and thereby injure the trees, besides leaving the ground in no better state than it is after carrots; for when the carrot is drawn, the cavity is filled immediately with loose mould, through which the young fibres will strike with great freedom, and very much accelerate the growth of the trees.”

4. PARSNIPS.

The cultivation of parsnips too much neglected.

Parsnips have never in this country received from husbandmen that attention to which they are well entitled from the ease with which they are cultivated, and the great quantity of saccharine or nourishing matter they are known to contain, which certainly abounds in them in a much greater proportion than in almost any other vegetable with which we are at present acquainted.

To cultivate this root* (says Mr Hazard), so as to make

* *Bath Papers*, vol. iv. p. 244.

make it advantageous to the farmer, it will be right to sow the seed in the autumn immediately after it is ripe; by which means the plants will appear early the following spring, and get strong before the weeds can rise to injure them. Neither the seeds nor young plants are ever materially injured by frosts; on which account, as well as many others, the autumn is preferable to the spring sowing. The best soil for them is a rich deep loam, and next to this sand. They will thrive well in a black gritty soil, but not in stone-brash, gravel, or clay; and they are always largest in the deepest earth. If the soil be proper, they do not require much manure. Mr Hazard obtained a very good crop for three years upon the same piece of ground without using any; but when he laid on about 40 cart loads of sand per acre upon a stiff loam, and ploughed it in, he found it answer very well; whence he concludes, that a mixture of soils may be proper for this root. The seed may be sown in drills to about 18 inches distance from one another, that the plants may be the more conveniently hand or horse-hoed; and they will be more luxuriant if they undergo a second hoeing, and are carefully earthed, so as not to cover the leaves. Such as have not ground to spare, or cannot get it in proper condition in autumn, may at that time sow a plot in their garden, and transplant from thence in the latter end of April, or early in the month of May following. The plants must be carefully drawn, and the ground well pulverized by harrowing and rolling; after which a furrow should be opened with the plough, about six or eight inches deep, in which the plants should be regularly laid at the distance of about ten inches from each other, taking care not

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Mr Hazard's method of cultivation.

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to let the root be bent, but the plant to stand perpendicular after the earth is closed about it, which ought to be done immediately by means of persons who should for this purpose follow the planter with a hoe. Another furrow must be opened about 18 inches from the former, in the same direction, and planted as before; and so on in like manner until all the plants are deposited, or the field be completely cropped; and, when the weeds appear, hoeing will be necessary, and it will afterwards be proper to earth them; but if the leaves of the plants be covered with earth, the roots will be injured. Parsnips ought not to be planted by dibbling, as the ground thus becomes so bound as seldom to admit the small lateral fibres with which these roots abound to fix in the earth, by which they are prevented from expanding themselves, and never attain a proper size. When circumstances are properly attended to, there is little doubt that a crop of parsnips would answer much better than a crop of carrots. They are equal, if not superior, in fattening pigs, as they make their flesh whiter, and the animals themselves are more fond of these roots than of carrots. Horses eat them greedily when clean washed and sliced among bran, and thrive very well upon them; and black cattle likewise greatly approve of them.

Culture in
France.

Though parsnips are little used in Britain, they are highly esteemed in some districts of France. In Brittany they are thought, as food for cattle, to be little inferior to wheat; and cows fed with them are said to give as much milk, and of as good quality, as in the summer months.

Mr Young states, in the following terms, his observations upon the subject when travelling in that province.

vince. "*Ponten to Morlaix.*—Many parsnips cultivated about a league to the left; they are sown alone and hoed. They are given to horses, and are reckoned so valuable that a journal is worth more than one of wheat. Nearer to Morlaix the road passes a few small pieces. They are on beds five or six yards broad with trenches digged between, and on the edges of those trenches a row of cabbages.

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"*Morlaix.*—About this place, and in general through the bishopric of St Pol de Leon, the culture of parsnips is of very great consequence to the people. Almost half the country subsists on them in winter, boiled in soup, &c. and their horses are generally fed with them. A horse load of about 300lb. sells commonly at three livres, in scarce years at four livres, and such a load is good food for a horse 15 days. At 60lb. to the bushel, this is five bushels; and 2s. 7½d. for that, is 6½d. per bushel of that weight. I made many inquiries how many loads on a journal, but no such thing as information tolerably to be depended upon; I must therefore guess the present crop by the examination I made of many, to amount to about 300 bushels or 350 per English acre. The common assertion, therefore, that a journal of parsnips is worth two of wheat seems to be well founded. The ground is all digged a full spit deep for them; they are kept clean by hand-weeding very accurately, but are left for want of hoeing beyond all comparison too thick. They are reckoned the best of all foods for a horse, and much exceeding oats; bullocks fatten quicker and better on them than on any other food; in short they are, for all sorts of stock, the most valuable produce found on a farm. The soil is a rich deep friable sandy loam."

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In the island of Jersey, parsnips have long been considered as of the highest importance ; and as the mode of cultivating them there seems worthy of attention, we shall here give an account of it, from a paper transmitted by the Agricultural Society of Jersey to the British Board of Agriculture.

Culture of
parsnips
with beans
in Jersey
and Guern-
sey.

“ It is impossible, say these gentlemen, to trace the period when the cultivation of this plant was first introduced amongst us. It has been known for several centuries, and the inhabitants have reaped such benefit therefrom, that, for fattening their cattle and pigs, they prefer it to all the known roots of both hemispheres. The cattle fed therewith yield a juicy and exquisite meat. The pork and beef of Jersey are incontestably equal, if not superior, to the best in Europe. We have observed, that the beef in summer is not equal to that in the autumn, winter, and spring periods, when the cattle are fed with parsnips ; which we attribute to the excellency of that root.

“ All animals eat it with avidity, and in preference to potatoes. We are ignorant of the reason, having never made any analysis of the parsnip. It would be curious, interesting, and useful, to investigate its characteristic principles : it is certain that animals are more fond of it than of any other root, and fatten more quickly. The parsnip possesses, without doubt, more nutritious juices than the potato. It has been proved that the latter contains eleven ounces and a half of water, and one gros of earthy substance, French weight ; therefore, there only remain four ounces and five gros of nutritive matter. Probably the parsnip does not contain near so much watery particles ; nevertheless, they digest very easily in the animal's body. The cows fed

fed with hay and parsnips during winter yield butter of a fine yellow hue, of a saffron tinge, as excellent as if they had been in the most luxuriant pasture.”

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These gentlemen proceed to state, that, in the island of Jersey, parsnips are not cultivated alone, but along with beans, among which last pease are sometimes mixed. There are three modes of cultivation: 1st, With the spade; 2d, With the plough and spade; and 3d, With two ploughs, the one called the small and the other the great plough. This last method, as being the most economical and advantageous to the husbandman, is the only one described. In the month of September, a slight ploughing and preparation is sometimes given to the field destined for beans and parsnips in the ensuing year; but more generally the whole work is performed in high grounds about the middle of February, and in the middle of March in low land. A light plough cuts and turns the earth about four or five inches deep; then follows it a large plough constructed on purpose, and only used for this operation, which elevates the earth on the furrow laid open, and turns it over that which the small plough turned up. The essential point is to plough deep, and to cover the clods over again.

The field thus prepared, is suffered to remain 15 days, after which it is very lightly harrowed. On the same day, or on the ensuing, the beans are planted in the following manner. Straight lines must be drawn from north to south with a gardener's rake at $4\frac{1}{2}$ feet distance. On these straight lines, 19 inches in breadth, women plant four or five beans in rows four inches distant from each other, or the beans are planted in double rows all over the field, at the usual depth, and 12 feet distance from each other, with the beans spaced out 18 inches from

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each other. When all this is done, the parsnips are sown in broad-cast over the field, after which it is well harrowed. In 15 days after, if the weather has been warm and rainy, or in three weeks if it has been cold and dry, the ground is harrowed again to cut up the weeds. In five or six weeks the beans shoot out, and the ground soon appears as if covered by hedges or laid out in paths for walking; for in the spaces between the lines where the beans were planted are as many alleys, where women and children weed with great facility. They generally weed the ground twice, and the operation is performed with a two-pronged fork, such as is used in gardens. The first weeding is performed at the end of April or beginning of May, when the plants must be cleared out if they are too thick. When the beans are ripe, which is in August or September, they are immediately plucked up, not to incommode the parsnips. The crop of beans is not always certain. If high winds or fogs prevail when they are in flower, the produce will be scanty; but the parsnips in a manner never fail. They neither dread the inclemency of the weather, nor are affected by the hardest frost, nor by any of those accidents which at times will instantly destroy a whole crop.

Parsnips grow till the end of September, but some give them to cattle they wish to fatten in the beginning of September. The people of these islands consider the parsnip as the most juicy and nutritious of all roots known. Its cultivation is an excellent preparation for wheat, which is sown there without manure after parsnips, and yields a plentiful crop. It must be observed, that though this cultivation of parsnips is expensive where the price of labour is high, no dung or manure

manure is necessary either for the parsnips or the wheat. They reckon 30 perches of parsnips, with a little hay, will fatten an ox of three or four years old, though ever so lean: he eats them in the course of three months as follows; they are given at six in the morning, at noon, and at eight at night, in rations of 40lb. each; the largest are slit into three or four pieces; but not washed unless very much covered with earth. In the intermediate hours, at nine in the morning, two in the afternoon, and nine at night, a little hay is given. Experience has shewn, that when cattle, pigs, or poultry, are fed with parsnips, they are sooner fattened and are more bulky than with any other root or vegetable whatever. The meat of such is most delicate and savoury. In spring the markets are furnished with the best and fattest beef from their feeding on parsnips. The crops of parsnips raised in Jersey and Guernsey are very great. On an extent of 1000 feet, the produce of a field of beans and parsnips is about 1200lb weight of parsnips, Rouen measure, and thirty cabots or half bushels of beans, and three cabots and a half of pease; which altogether, according to the price at which these articles are actually sold there, amount to the sum of 256 livres French currency. The following information was also received from the president of the Jersey Society on 1st March 1796, viz. "Since writing concerning the crop of beans and parsnips together, we have found that an individual who cultivates parsnips without sowing either pease or beans along with them had a crop of 14,760lb. weight of Rouen measure per vergee." The vergee is 40 perches in length and one perch in breadth.

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III. *Plants cultivated for Leaves, or for both Leaves and Root.*

I. TURNIP-ROOTED CABBAGE.

Cultivation
of the tur-
nip-rooted
cabbage.

This plant may deservedly be reckoned next in value to the turnip itself. Its advantages, according to Sir Thomas Beevor, are, "that it affords food for cattle late in the spring, and resists mildew and frost, which sometimes destroy the common turnip;" whence he is of opinion that every farmer who cultivates the common turnip should always have part of his farm laid out in the cultivation of this root. The importance and value of turnip-rooted cabbages seem only to have been lately ascertained. In the Bath Society papers we have the following account of Sir Thomas Beevor's method of cultivating them; which from experience he found to be cheaper and better than any other.

Their utility and value.

"In the first or second week of June, I sow the same quantity of seed, hoe the plants at the same size, leave them at the same distance from each other, and treat them in all respects like the common turnip. In this method I have always obtained a plentiful crop of them; to ascertain the value of which I need only inform you, that on the 23d day of April last, having then two acres left of my crop, sound, and in great perfection, I divided them by fold hurdles into three parts of nearly equal dimensions. Into the first part I put 24 small bullocks of about 30 stone weight each (14lb. to the stone), and 30 middle-sized fat wethers, which, at the end of the first week, after they had eaten down the greater part of the leaves, and some part of the roots, I shifted into the second division, and then put

put 70 lean sheep into what was left of the first ; these fed off the remainder of the turnips left by the fat stock ; and so they were shifted through the three divisions, the lean stock following the fat as they wanted food, until the whole was consumed.

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“ The 24 bullocks and 30 fat weathers continued in the turnips until the 21st of May, being exactly four weeks ; and the 70 lean sheep until the 29th, which is one day over four weeks : so that the two acres kept me 24 small bullocks and 110 sheep four weeks (not reckoning the overplus day of keeping the lean sheep) ; the value, at the rate of keeping at that season, cannot be estimated in any common year at less than 4d. 2-week for each sheep, and 1s. 6d. per week for each bullock, which would amount together to the sum of 14l. 10s. 8d. for the two acres.

“ You will hardly, I conceive, think I have set the price of keeping the stock at too high a rate ; it is beneath the price here in almost every spring, and in this last it would have cost double, could it have been procured : which was so far from being the case, that hundreds of sheep and lambs here were lost, and the rest greatly pinched, for want of food.

“ You will observe, gentlemen, that in the valuation of the crop above mentioned I have claimed no allowance for the great benefit the farmer receives by being enabled to suffer his grass to get into a forward growth, nor for the superior quality of these turnips in fattening his stock ; both which circumstances must stamp a new and a great additional value upon them. But as their continuance on the land may seem to be injurious to the succeeding crop, and indeed will deprive the farmer totally of either oats or barley ; so to supply

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supply that loss I have always sown buck-wheat on the first earth upon the land from which the turnips were thus fed off; allowing one bushel of seed per acre, for which I commonly receive from five to six quarters per acre in return. And that I may not throw that part of my land out of the same course of tillage with the rest, I sow my clover or other grass seeds with the buck-wheat, in the same manner as with the oat or barley crops, and have always found as good a *layer* (ley) of it afterwards.

“ Thus you see, that in providing a most incomparable vegetable food for cattle, in that season of the year in which the farmer is generally most distressed, and his cattle almost starved, a considerable profit may likewise be obtained, much beyond what is usually derived from his former practice, by the great produce and price of a crop raised at so easy an expence as that of buck-wheat, which with us sells commonly at the same price as barley, oftentimes more, and but very rarely for less.

“ The land on which I have usually sown turnip-rooted cabbages is a dry mixed soil, worth 15s. per acre.”

Recommendation
by the Bath
Society.

To the preceding account the Society have subjoined the following note: “ Whether we regard the importance of the subject, or the clear and practical information which the foregoing letter conveys, it may be considered as truly interesting as any we have ever been favoured with: and therefore it is recommended in the strongest manner to farmers in general, that they adopt a mode of practice so decisively ascertained to be in a high degree judicious and profitable.”

To raise the turnip-rooted cabbage for transplanting,
the

the best method yet discovered is, to breast-plough and burn as much old pasture as may be judged necessary for the seed-bed ; two perches well stocked with plants will be sufficient to plant an acre. The land should be dug as shallow as possible, turning the ashes in ; and the seed should be sown the beginning of April.

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The land intended for the plantation to be cultivated and dunged as for the common turnip. About midsummer (or sooner if the weather will permit) will be a proper time for planting, which is best done in the following manner : the land to be thrown into *one-bout* ridges, upon the tops of which the plants are to be set, at about 18 inches distance from each other. As soon as the weeds rise, give a hand-hoeing ; afterwards run the ploughs in the intervals, and fetch a furrow from each ridge, which, after lying a fortnight or three weeks, is again thrown back to the ridges ; if the weeds rise again, it is necessary to give them another hand-hoeing.

To raise the turnip-rooted cabbage for transplanting.

If the young plants in the seed-bed should be attacked by the fly, sow wood-ashes over them when the dew is on, which will effectually prevent the ravages they would otherwise make.

In another letter from Sir Thomas Beevor, Bath Papers, vol. viii. p. 489. he expresses his hope that the turnip-rooted cabbages he had would last until he should have plenty of grafts for all his stock. To make a comparative estimation of the quantity of food yielded by the turnip-rooted cabbage and the common turnip, he selected some of each kind, and having girted them with as much accuracy as possible ; he found, that a turnip-rooted cabbage of 18 inches circumference weighed 4 lb. and a common turnip of the same size only

Comparison of the quantity of food in this and in the common turnip.

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only 3½lb.; on trying others, the general result was found to be in that proportion. Had they been weighed with the tops, the superiority of the turnip-rooted cabbage would have been greater, the tops of them being remarkably bushy. They were weighed in the month of March; but had this been done at Christmas, our author is of opinion that the difference would not have been so great; though he reckons this very circumstance of their continuing so long to afford a nourishing food, an instance of their excellency above almost every other vegetable whatever.

Other ex-
periments.

In the fourth volume of the same work, Sir Thomas gives an account of another experiment on five acres of turnip-rooted cabbage, four of which were eaten upon the field, the other was pulled up and carried to the stables and ox-houses. They were sown and cultivated as other turnips; the beasts were put to them on the 12th of April, and continued feeding upon them till the 11th of May. The cattle fed for this space of time were, 12 Scotch bullocks weighing 40 stone each; eight homebreds, two years old; fifteen cows full-sized; 40 sheep; 18 horses; besides 40 store-hogs and pigs, which lived upon the broken pieces and offal, without any other allowance, for the whole four weeks. The whole value of the plant, exclusive of the feeding of the pigs, amounted, according to our author's calculation, to 18l.; and he says that the farmers would willingly give this sum in the spring for feeding as many cattle: "because it enables them to save the young shooting grafs (which is so frequently injured by the tread of the cattle in the frosty nights) until it gets to such a length and thickness as to be afterwards but little affected by the summer's drough.

Besides

Besides this, the tops or leaves are in the spring much more abundant, and much better food than those of the common turnip, as already observed; and they continue in full perfection after all the common turnips are rotten or worthless.

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The disadvantages attending the cultivation of turnip-rooted cabbages are, that they require a great deal of time and pains to take them up out of the ground, if they are to be carried off the field; and if fed where they grow, it requires almost an equal labour to take up the pieces left by the cattle. A great deal of earth is also taken up along with the root; and the substance of the latter is so firm and solid, that they must be cut in two in order to enable the cattle to eat them. To obviate some of these objections, it will be proper to sow the plants on rich and very light land; and as they are longer in coming to the hoc than the common turnip, it will be proper to sow them about the beginning of June.

Disadvantages attending the cultivation of this plant.

In another experiment upon this plant by the same gentleman, the cabbages held out during the long and severe frost of 1788 without the least injury, though it destroyed three-fourths of all the common turnips in the neighbourhood. On the 21st of April 1789, the average produce of an acre was found to be somewhat more than $24\frac{1}{2}$ tons, though the tops had not sprouted above three inches. Considering the precariousness of turnips and other crops, Sir Thomas is decisively of opinion, that all farmers ought to have as many turnip-rooted cabbages as would afford and ensure them a full provision for their cattle for about three or four weeks during the latter part of the spring. This quantity he reckons sufficient, as the consumption, particularly when

Why every farmer ought to cultivate this plant.

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when drawn and carried off the land, is attended with more trouble and expence than that of common turnips, especially if the soil be wet and heavy. In another letter, dated May 3. 1790, Sir Thomas Beever once more sets forth the advantages of having a crop of these vegetables during the spring season. "In consequence (says he) of the very cold weather we have had here, the grass is but just springing; as the turnips are wholly eaten up, it occasions much distress among the farmers for want of some green vegetable food for their sheep and cattle; whereas, by the assistance of my turnip-rooted cabbages, I have abundance of the best and most nutritive food that can be found them." He then proceeds to recommend their culture "for the support of almost all live stock for the three last weeks of April, or first week of May, when the grass shoots late."

In the 4th volume of the Transactions of the Society for encouraging Arts, Mr Robins, who received a premium for raising the greatest quantity of this plant, informs us, that the soil on which it grew was a *stone braish*, inclining to sand, not worth more than 10s. per acre; the preparation the same as for turnips. The manure was a compost of earth and dung, which he finds to answer better than dung. The seed was sown about the beginning of April on a clean spot of ground; and he commonly uses an old pasture where the sheep-fold has been in the winter, after taking away the dung, and digging it very shallow; "as the roots of the young plants (says he) might soon reach the dung or salts, which must consequently be left, in order to force them out of the fly's way." These insects, our author observes, are extremely fond of the
turnip-

turnip-rooted cabbage; much more so, he believes, than ~~the~~ common turnips. About the middle of June they should be planted out upon one-bout ridges raised by a double plough made for the purpose. Seven thousand plants are sufficient for one acre; but if only six are used, the roots will be the larger.

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To determine how many sheep might be kept upon an acre of turnip-rooted cabbage, our author shut up 200 ewes with their lambs upon a piece of poor pasture land of no great extent; the whole not exceeding ten acres. One ton was found sufficient for keeping them in sufficient health for a day. On giving them a larger piece of ground to run over, though it had been eaten all winter and late in the spring, yet, with this trifling assistance, 13 tons of turnip-cabbage were made to serve 18 days; at the end of which the ewes and lambs were found very much improved, which could not have been expected from four acres of turnips in the month of April, the time that these were fed.

Number of
sheep fed
by an acre
of turnip-
rooted cab-
bages.

From some trials made on the turnip-rooted cabbage at Cullen House in the north of Scotland, it appears that the plant is adapted to the climate of every part of our island. The first trial was made in the year 1784. The seeds were sown about the middle of March in garden ground properly prepared. The cabbages were transplanted about the middle of March that year into a dry light soil, well cleaned and dunged with rotten cow-dung, in rows three feet distant from each other, and at the distance of 20 inches in the rows. They were kept very clean, and the earth was hoed up to the roots of the plants; by which means they were probably prevented from attaining the hardness they would otherwise have arrived at; though,

Experi-
ments at
Cullen-
house.

Culture of particular Plants. though, after all, it was necessary to cut the roots in two before the sheep could eat them. When this was cut, the animals ate them greedily, and even preferred them to every other food. The roots continued good for at least a month after the common turnips were unfit for use: some of them weighed from eight to ten pounds, and a few of them more. Other trials have since been made; and it now appears that the plant will thrive very well with the ordinary culture of turnips in the open fields, and in the usual manner of sowing broad-cast. From a comparative trial made by the earl of Fife upon this root with some others, the quantities produced upon 100 square yards of ground were as follows:

			stone.	lb.
Common turnips	-	-	92	4
Turnip-rooted cabbage	-	-	88	0
Carrots	-	-	95	0
Root of scarcity	-	-	77	0

The turnip-rooted cabbage was planted in lines 20 inches asunder; the common turnips sown broad-cast, and hand-weeded, so that they came up very thick, being not more than three or four inches asunder when full grown. Two cows were fed for six weeks with the turnips, two with the turnip-rooted cabbage, and two with the root of scarcity for an equal time: the two fed with turnips gave most milk, and those with the root of scarcity the least. His lordship observes, however, that carrots thrive better on his farm than any other crop: that his horses had been fed on them at the rate of two pecks a-day, with no corn, and little more than half the usual quantity of hay. "They were kept

kept at work every day from seven to eight hours, and were never in better order."

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2. SWEDISH TURNIP, OR ROOTA BAGA.

The roota бага, or Swedish turnip, is a plant from which great expectations have been formed. It is said to be hardier than the common turnip, and of greater sweetness and solidity. It also preserves its freshness and succulence till a very late period of its growth, even after it has produced seed; on account of which property it has been recommended to the notice of farmers as an excellent kind of succulent food for domestic animals in the spring of the year, when common turnips and most other winter crops have failed, and before grass has got up to furnish an abundant bite for feeding beasts. This peculiarity, so valuable, yet so singular as to have led many at first to doubt the fact, seems to be sufficiently ascertained by experiment. Dr J. Anderson * in particular informs us, that it "begins to send out its flower-stems in the spring, nearly about the same time with the common turnip; but that the root, in consequence of that change of state, suffers very little alteration. I continued to use these turnips at my table every day till towards the middle of May; and had I never gone into the garden myself, I should not even then have suspected, from the taste or appearance of the bulb itself, that it had been shot at all. The stems, however, at the season I gave over using them, were from four to five feet high, and in full flower. I should have continued the experiment longer,

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had

* The *Bee*, vol. iii. p. 291.

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“ This experiment, however, fully proves, that this kind of turnip may be employed as a succulent food for cattle till the middle of May at least, in an ordinary year; and I have not the smallest doubt but it will continue perfectly good for that purpose till the end of May in any season; at which time grass and other spring crops can easily be had for bringing beasts forward in flesh. I can therefore, without hesitation, recommend this plant to the farmer as a most valuable spring feeding for cattle and sheep; and for this purpose, I think no wise farmer should be without a proportion of this kind of turnip to succeed the other sorts after they fail. The profitable method of consuming it, where it is to be kept very late, is, I am convinced, to cut off the tops with a scythe or sickle when from one foot to eighteen inches high, to induce it to send out fresh stems, that will continue soft and succulent to the end; whereas, without this process, the stems would become sticky and useless.

“ I cannot, however, recommend this kind of turnip, from what I have yet seen, as a general crop; because I think it probable, that unless in particular circumstances, the common field turnips grow to a much larger size, and afford upon the whole a more weighty crop. These, therefore, should still continue to be cultivated for winter use, the other being reserved only for spring consumption.

“ Experiments are still wanting to ascertain with certainty the peculiar soil and culture that best agree with this plant; but from the few observations I have hitherto had an opportunity of making upon it, it seems

to me probable, that it thrives better, and grows to a large size on damp clayey soil, than on light sandy land. But I would not wish to be understood as here speaking positively; I merely throw it out as a hint for future observation: on spongy soil it prospers.

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“ Though the uses of this as a garden plant are of much smaller consequence than those above specified, it may not be improper to remark, that its leaves form a very sweet kind of greens at any time; and merely for the sake of the experiment, I caused some of these to be picked off the stems of the plants coming to seed, on the 4th of June, the king’s birth-day, which, on being readied, were found perfectly sweet, without the smallest tendency to bitterness, which most, if not all, other kinds of greens that have been hitherto cultivated are known to acquire after their stems are considerably advanced; no family, therefore, can ever be at a loss for greens when they have any of this plant in seed.

“ A root of this kind of turnip was taken up this day (June 15.); the seed-stalks were firm and woody, the pods full formed, and in some of them the seeds were nearly ripe. The root, however, was as soft and succulent as at any former period of its growth; nor was the skin, as I expected, hard or woody. It was made ready and brought to the table: some persons there thought the taste as good, if not better, than at any former period of its growth; but I myself, perhaps through prejudice, thought it had not quite so high a relish as in winter: At any rate, however, there can be no doubt, that if ever it could be necessary, it might, even now, be employed very properly as a feed-
ing for cattle.”

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Culture of
the roota
baga in
Notting-
hamshire.

This vegetable, from its obvious utility, is gradually coming to be much used in various quarters of the island. In the Agricultural Survey of Nottinghamshire, the following description of the modes in which it has been successfully cultivated, is well worthy of attention. "The roota бага, or Swedish turnip, is now cultivated by a few farmers in this district. It appears to be superior to the common turnip in many respects, particularly in hardiness, as it stood the last severe winter without the least injury. It is eaten with greediness by all animals, from the horse to the swine. Sheep prefer it to all others; but the material advantage that has been made of it, is the substituting it for corn in the food of draught horses; in which it has been found to answer the wish of every person who has yet tried it. The turnips are put into a tub or barrel, and cut small with an instrument like a hoe, with the blade put perpendicularly into the shaft; a man will cut in one hour as much as six horses can eat in twenty-four. The tops and bottoms are previously cut off and given to the pigs. Horses that are hard worked, look full as well when fed with this turnip and very little hay, as they formerly did when very high fed with corn. The Swedish turnip should be sowed early, from the 15th of May to the 10th of June."—The following information on the culture of the roota бага, is given in the same Survey upon the authority of J. Daiken, Esq. of Nottingham.

Mr Daiken, about the 10th of May 1794, sowed about four acres with the seed of roota бага, about 2 lbs. per acre, on good sand land, worth 20s. an acre, manured as for turnips, and having been ploughed four or five times; the rest of the field, to the amount

or nine acres in all, with common turnip and turnip-rooted cabbage, all broad-cast. They were not transplanted, but hoed out nine inches asunder, at three hoeings, at 7s. 6d. an acre; no other culture. In November, began to use them for horses, giving at first clover and rye-grass hay, oats and beans; but finding that the horses did well upon them, left off all corn, and continued them on hay and the roots only; fifteen were thus fed for about two months, were constantly hard worked, and preserved themselves in very good condition. Mr Daiken is so well convinced, that in this application they were worth 3ol. an acre, that he would in future, if he could not get them otherwise, rather give that sum per acre for one or two acres, than not have them for this use. They lost their leaves entirely when the frost set in; but the roots were not the least affected, though the common turnips in the same field were totally destroyed. Passengers passing through the field, cut holes in them, which did not let the frost injure them; nor were those hurt which were damaged by cattle biting them. Some came to the weight of 16lbs. and Mr Daiken thinks the average of the crop 8lbs. and much to exceed in tonnage per acre common turnips.

Mr Daiken gave them also to hogs, cattle, and sheep. They are excellent for hogs; and sheep being let into the field before the common turnips were destroyed, gave so decided a preference to the root cabbage, that they would not settle on the common turnips while the others were to be had.

The method of giving them to horses is to cut off the tap-root, to wash them, and to cut them roughly with a perpendicular hoe, and then give them directly,

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without keeping them to dry. The horses ate them with avidity, and seemed even to prefer them to corn. Their qualities appear to be singular, as they bind horses instead of relaxing them as other roots do. One mare was kept entirely upon them and straw, worked every day, did well, and never looked better; this mare was more bound by them than the best. They have a strong effect upon making the coats fine; and one or two affected by the grease, were cured by them, as they act as a strong diuretic. In this mode of application, one acre maintained fifteen about two months: and Mr Daiken is so well convinced of the utility of the plant, as well as many of his neighbours, that he intends, and they also, to increase the cultivation much.

Mr Daiken suspects there are two sorts of the roota-baga, because some, upon cutting, are white within, but in general yellow; otherwise of the same external appearance. The yellow is the best.

Mr Robertson of Midlothian has remarked * that "the Swedish turnip is perhaps not so beneficial in some respects as the common turnip; but as it admits of being transplanted with advantage, it is surely an object of attention to the turnip-farmers, as by the means of it they can fill up any vacancies in the drills of the common kind with very little expence, which is hardly practicable by any other means. Even where the turnip fails altogether, as by the fly or slugs, the crop can be more readily renewed from a seed-bed of roota-baga.

* *Annals of Agriculture*, vol. xxvi.

that from re-sowing the field, which seldom comes to much good.”

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The following communication, procured by favour of the honourable Baron Cockburn, sets the Swedish turnip in a still more favourable light.

“This plant is the best calculated of any for a northern climate: it stands frost well; keeps wonderfully when headed with straw, built in stooks, which becomes in a great measure necessary, as hares resort to it from all quarters, and will touch no other root while any of it remains.” It eats as well after it is shot, and sheds its seed, as it does before. I saw some at the duke of Buccleugh’s farm, which, with several others, had been lifted and stacked the first week in November, at Dalkeith, after the winterers had been turned to grass, one root of which I carried home, and found it, when boiled, eat as well as it would have done in the month of October.

“Cattle are much fonder of them than turnips, inasmuch, that, when put into a straw yard together, the turnips are never touched until the other is entirely eaten up: nay, after having been accustomed for some time to the Swedish plant, they have been found to refuse turnips for many hours; and even when compelled by hunger, to take them with a seeming reluctance. The superior nutritious quality of the plant is pretty well ascertained from this fact, that, upon a comparison of a number of square inches of a single root against the same of field turnips, the weight was a third more; and cattle fed upon it, put up at the same time with others upon turnips, advanced more in a month than the others did in six weeks. Upon land prepared for turnips, the proper season for sowing it is about

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the 10th of May, and not much later. It has been tried in February, when early garden turnips are sown, but it always failed, growing to the stalk only without any root; when sown after May it seldom came to any tolerable size. Hares do not much take to it until the end of October, when the frost commonly begins; but, as it can then be stacked, this objection is removed; and likewise the trouble attending the supply of cattle, during a storm, with turnips, which will not suffer to be kept long after being taken out of the ground. The shaws of this plant, when carefully stripped, are found to be an excellent kitchen green, and a good substitute for spinach."

Dr Campbell of Lancaster*, says of some Swedish turnips sown by him in 1798, that "they attained a good size, and were not at all affected by the severe frost of that winter, which destroyed the general crop of other turnips. The thermometer fell on the 27th of December of that year to 12 degrees of Fahrenheit, which is an intensity of cold that the common turnip cannot withstand. It is certainly an acquisition of no common magnitude to have a winter food for cattle, which is inaccessible to frost, so that it can at all times be taken fresh from the field where it grows, (for however the ground be frozen, they may be got up by means of a pick-axe), and which continues in perfection through the whole spring of the year, so late as the month of May, and until grass spring again. These properties of the Swedish turnip point out the propriety of its constituting a part of the winter food, at least in every

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every person who has a stock of cattle. It seldom happens that any frost so severe as materially to injure the turnips occurs before Christmas; and if the common sorts were to be resorted to until about that period, and the Swedish for the remainder of the season, we should have for certain a supply as to bid defiance to any inclemency of weather.

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“ There is one circumstance attending the cultivation of the Swedish turnips which deserves attention; which is, that they will not come to a good size, except with a large quantity of manure (stable dung.) I have understood, that they have been tried in many places in this neighbourhood, and fallen into disrepute from their not acquiring any greater size than a carrot, which has been owing to the circumstance alluded to, as I have myself found to be the case, where the full quantity of dung had not been used. It appears too, that from this circumstance the drill system is particularly suited to the cultivation and growth of this species of turnip, as the roots are so certain to meet with dung beneath. Those I have raised, particularly the present year, are of a good size, as large as eight or nine pounds weight. They are so much more solid than the common turnips, that on weighing a load of three Winchester bushels of each, the one weighed 180 pounds, whilst the other was 264 pounds weight.

“ It is recommended to sow the seed in May, in order to give this species of turnip an opportunity of acquiring its full size. Although circumstances have hitherto prevented mine from being sown earlier than the first week in June, they have acquired a very tolerable magnitude; but perhaps it might have been better had it been done at an earlier period.

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"For the table they are certainly the best turnips that have been yet introduced; and, where they are known, bear a decided preference in the market."

"I am sorry to observe an inferior variety of the turnip becoming more general for these two last years; it is not distinguishable whilst growing, but is upon pulling. The kind is white, whilst the ~~white~~ ^{yellow} is yellow; this puts out large tap-roots, which renders it unsightly and less marketable, whilst the other is round and compact as to its roots. It is also less palatable for the table. Great attention will be necessary on the part of those who raise the seed to get rid of this species, otherwise this turnip may get into unmerited disrepute."

3. TURNIP CABBAGE.

This plant is as yet but little known. The seed is said to have been brought from the Cape of Good Hope by Mr Hastings, where it is very common, as well as in Holland. It has also had an existence in Britain for many years, though not generally known. It has a much greater affinity to the cabbage than to the turnip; and is very hardy, bearing the winter as well, if not better, than common brocoli, and may therefore be considered as a valuable acquisition to the

Method of
cultivation

kitchen garden as well as for cattle. The best time for sowing it for the garden is the end of May or beginning of June, though none of the plants have ever been observed to run to seed, though sown ever so early. Even though sown in August, at the ~~season~~ ^{season}, the greater part stood throughout the following summer, and did not seed till the second spring. The plants require nearly the same management with brocoli,

brocoli, at a distance, transplanting, &c. and are usually most esteemed when young, and about the size of a moderate garden turnip; those sown in June will continue all winter. The bulb must be stripped clean of its thick fibrous rind; after which it may be used as a common turnip. The crown or sprout is very good, but especially in the spring, when they begin to run to seed. Mr Broughton, from whose account in the Bath Papers, vol. v. this article is taken, thinks that the turnip-cabbage is more nutritious than the common turnip. The largest bulb he measured was 23 inches circumference; but the thickness of the rind is so great, that some farmers imagined that the bulb would be too hard for sheep. The objection, however, was obviated by Mr Broughton, who gave some of the oldest and toughest bulbs to his sheep, and found that they not only penetrated through the rind, but even devoured the greatest part of it.

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4. CABBAGE.

The cabbage has been recommended by long experience as an excellent food for cattle. Its uses as a part of human food are also well known. It is therefore an interesting article in husbandry. It is easily raised, is subject to few diseases, resists frosts more than turnip, is palatable to cattle, and sooner fills them than turnip, carrot, or potatoes.

Culture of
cabbage.

Mr Young remarks * that "the culture of cabbages for cattle, is one of the most important objects in ~~English~~ agriculture; without which, large stocks of cattle

* *Travels*, vol. ii.

Culture of particular Plants. cattle or sheep are not to be kept on soils improper for turnips. They are, in every respect but one, preferable to that root; the only inferiority is, that of cabbages demanding dung on all soils, whereas good land will yield turnips without manuring."

Season of planting. The season for setting cabbage depends on the use it is intended for. If intended for feeding, in November, December, and January, plants procured from seed sown the end of July the preceding year must be set in March or April. If intended for feeding in March, April, and May, the plants must be set the first week of the preceding July, from seed sown in the end of February or beginning of March the same year. The late setting of the plants retards their growth; by which means they have a vigorous growth the following spring. And this crop makes an important link in the chain that connects winter and summer green food.

Advantage of repeated transplanting. Mr Vancouver suggests that a single transplanting of cabbages is not sufficient for their proper cultivation. "A few words, says he *, with regard to the culture of cabbages will be sufficient to point out the necessity of an intermediate transplanting of the young plants between the seed-bed and the field; for when the plants are drawn from the seed-bed, and put directly into the field, they are found to be out of all proportion, tall, slender, and altogether unfit for their new and exposed situation; to this must be added, a long tap-root without lateral fibres; and which necessarily undergoes several twists and doubles in the hole by the operation of planting; here the plant languishes till its lateral roots are

* *Annals of Agriculture*, vol. xxv.

are formed, which it is gradually doing as the tap-root decays. As the season may be more or less kind, the plant may droop for a while; but it too often happens, and that in despite of the most unwearied industry, that the plant loses its life and its tap-root together; hence arises the necessity of such frequent replantings, and herein lurks the cause of that universal languor which so long prevails through all the fields of cabbages that are thus transplanted into the field directly from the seed-bed. It is the nature of the cabbage to lose its tap-root upon its first removal, and in its place is put forth a bunch of lateral roots just below the surface of the ground. The stem of the plant then begins to strengthen, and its leaves to spread. This change in the root being completed from an intermediate transplanting, the young plant will be the better able to combat the hardships of its new situation in the field; for being already furnished with lateral roots, its nourishment from the ground will be immediate and certain; it will flourish and come to an early maturity, rather than languish for a while, and then perish as thousands now do; or creep slowly on, till, late in the season, they arrive at a stunted and unprofitable end. In proportion as the lateral roots increase and collect nourishment, the plant heads and flourishes; nor would the kindliest plant, upon the most favoured soil, cabbage, or even come to perfection, were it not by some means or other deprived of its tap-root. The expence therefore of an intermediate transplanting between the seed-bed and the field, to those who are desirous of excelling in the culture of cabbages, can bear no proportion whatever to the labour, expence, and disappointment, that

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particular
Plants.

Prepara-
tion of the
soil.

that must for ever await the want of so material a training and preparation of the infant plant."

And now to prepare a field for cabbage. Where the plants are to be set in March, the field must be made up after harvest in ridges three feet wide. In that form let it lie all winter, to be mellowed with air and frost. In March, take the first opportunity, between wet and dry, to lay dung in the furrow. Cover the dung with a plough, which will convert the furrow into a crown, and consequently the crown into a furrow. Set the plants upon the dung, distant from each other three feet. Plant them so as to make a straight line cross the ridges, as well as along the furrows, to which a gardeners line stretched perpendicularly cross the furrows will be requisite. This will set each plant at the distance precisely of three feet from the plants that surround it. The purpose of this accuracy is to give opportunity for ploughing not only along the ridges, but cross them. This mode is attended with three signal advantages: it saves hand-hoeing, it is a more complete dressing to the soil, and it lays earth neatly round every plant.

If the soil be deep and composed of good earth, a trench-ploughing after the preceding crop will not be amiss; in which case, the time for dividing the field into three-feet ridges, as above, ought to be immediately before the dunging for the plants.

If weeds happen to rise so close to the plants as not to be reached by the plough, it will require very little labour to destroy them with a hand-hoe.

Unless the soil be much infected with annuals, twice ploughing after the plants are set will be a sufficient dressing. The first removes the earth from the plants;

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the next, at the distance of a month or so, lays it back.

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Where the plants are to be set in July, the field must be ribbed as directed for barley. It ought to have a light ploughing in June before the planting, in order to loosen the soil, but not so as to bury the surface-earth; after which the three-feet ridges must be formed, and the other particulars carried on as directed above with respect to plants that are to be set in March.

In a paper already quoted from those of the Bath Society, Scots cabbages are compared, as to their utility in feeding cattle, with turnips, turnip-rooted cabbage, and carrots. In this trial the cabbages stand next in value to the carrots; and they are recommended as not liable to be affected by frost, if they be of the true flat-topped firm kind. Fifty-four tons have been raised upon an acre of ground not worth more than 12 shillings. There is likewise an advantage attending the feeding of cattle with cabbages, viz. that their dung is more in proportion than when fed with turnips or with hay; the former going off more by urine, and the latter having too little moisture. They also impoverish the ground much less than grain. Mr Billingsley accounts 46 tons per acre a greater crop than he ever read of: but Mr Vagg, in the 4th volume of Bath Papers, gives an account of a crop for which he received a premium from the Society, which was much superior to that of Mr Billingsley. Its extent was 12 acres; the produce of the worst was 42, and of the best 68 tons. They were manured with a compost of lime, weeds, and earth, that lay under the hedges round the field, and a layer of dung, all mixed and

Quantity
raised on
an acre, &c.

Culture of
particular
Plants.

and turned together. About 25 cart loads of this were spread upon an acre with the usual ploughing given to a common summer fallow; but for this, he says, "admitting such a crop to exhaust the manure in some degree by its growth, an ample restoration will be made by its refuse ploughed in, and by the stirring and cleaning of the ground." The whole expence of an acre, exclusive of the rent, according to Mr Vagg's calculation, amounts to 1l. 14s. 1d. only four ounces of seed being requisite for an acre. The 12 acres, producing as above mentioned, would feed 45 oxen, and upwards of 60 sheep, for three months; improving them as much as the grass in the best months of the year, May, June, and July. He recommends sowing the seed about the middle of August, and transplanting the young cabbages where they may be sheltered from the frost; and to the neglect of this he ascribes the partial failure, or at least inferiority, of one part of his ground in the crop just mentioned, the young plants not being removed till near midsummer, and then in so dry a time, that they were almost scorched up.

Of water-
ing cab-
bages.

In the Farmer's Magazine, vol. ii. p. 217. we have several pertinent remarks upon the culture of this useful plant, particularly with regard to watering. "It is a rule (says this correspondent) never to water the plants, let the season be as dry as it may; insisting that it is entirely useless. If the land is in fine tilth and well dunged, this may be right, as the expence must be considerable; but it is probable, in very dry seasons, when the new set plants have nothing but a burning sun on them, that watering would save vast numbers, and might very well answer the expence, if

a pond is near, and the work done with a water-cart." He takes notice also of another use of cabbages, which has not met with the attention it merits, viz. the planting of lands where turnips have failed. A late sown crop of these seldom turns to any account; but cabbages planted on the ground without any ploughing would prove very beneficial for sheep late in the spring; in all probability (unless on light, sandy, or limestone soils) of greater value than the turnips, had they succeeded.

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Mr Marshall observes, that in the midland district, a valuable sort of large green cabbage "is propagated, if not raised, by Mr Bakewell, who is not more celebrated for his breed of rams than for his breed of cabbages. Great care is observed here in raising the seed, being careful to suffer no other variety of the brassica tribe to blow near seed cabbages; by which means they are kept true to their kind. To this end, it is said that some plant them in a piece of wheat; a good method, provided the seed in that situation can be preserved from birds."

Cabbages cultivated in the midland district.

The advantage of having large cabbages is that of being able to plant them wide enough from each other, to admit of their being cleaned with the plough, and yet to afford a full crop. The proper distance depends in some measure on the natural size of the species and the strength of the soil; the thinner they stand, the larger they will grow: but our author is of opinion that cabbages, as well as turnips, are frequently set out too thin. Four feet by two and a half, according to Mr Marshall, are a full distance for large cabbages on a rich soil.

Distance at which they ought to be placed.

We think it of importance to take notice of the

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particular
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Method of
transplant-
ing and
earthing
them.

following mode of transplanting full-grown cabbages, or earthing them, as being consistent with the best mode of practice, and coming from the most respectable practical authority, Mr George Cully of Fenton. "We plant the cabbages, says he *, not only in right lines but equidistant every way, so that we can plough between the rows, both long-ways and cros over ; which, by loosening the earth so effectually on all sides, very much promotes their growth. But the matter I wished to inform you of, is the taking them up by the roots in the autumn whenever they have completed their growth, and putting them into the nearest stubble field you have, where a plough is ready to draw a straight furrow in the most convenient place ; and at twenty yards distance, more or less, the ploughman makes another furrow parallel to the first. The cabbages are now turned out of the carts as conveniently as may be for a sufficient number of women to lay them along these furrows as close one to another as possible. The ploughman begins again where he first started, and turns a large furrow upon the cabbages, which is trodden down and righted by one, two, or more, as occasion requires, with each a spade in his hand, to assist where the plough has by chance or accident not thrown earth enough. Thus the work goes on till all is finished.

"We think we derive two advantages by the above process. In the first place, the cabbages keep sufficiently well through the winter in their new situation, while they do not draw or exhaust the land so much where they were growing : and, secondly, that land is
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* *Annals of Agriculture*, vol. xv.

at liberty to be sown with wheat as soon as cleared of the cabbages ; which grain, in general, answers well after that green crop.”

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particular
Plants.

Cabbages and greens in general are apt to be infested by caterpillars. They may usually however be protected against those vermin by pulling off the large undermost leaves, which may be given to cows in the month of August, or when the common white butterflies begin to appear in numbers. These butterflies lay their eggs, which produce the cabbage caterpillar, on the under side of the largest leaves of the cabbage plants. There is also said to be another remedy. It consists of sowing beans among the cabbages, which will greatly prevent the breeding of these worms ; for it is said that the butterflies have an antipathy to the flavour of beans.

How pro-
tected from
caterpil-
lars.

Mr Young * takes notice of his having seen in an agricultural tour through Suffex another mode of accomplishing this object, which was used by a farmer, whose practice in other points of view appears respectable. “ Cabbages he (Mr Millward) finds to be excellent food for his fat sheep ; he sows the drum-head cabbage about the middle of February in the warmest part of a field ; and as they spring up he sprinkles ashes over the ground to destroy the fly. During the summer he plants them out three feet square, upon land neither stiff nor light ; they are afterwards horse-hoed and landed up. If caterpillars infest the land he strews tarred rags over the fields, or hangs the rags dipped in tar upon sticks a foot high, early in the summer, to prevent the butterfly from settling on the plant and engendering the ca-

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terpillar.

Culture of terpillar. Cabbages will last from September to Fe-
 particular bruary."
 Plants.

5. COLEWORTS, or OPEN KAIL.

These are in Scotland universally cultivated in every cottager's garden, (hence called the *kail-yard*.) They have been known to thrive on the same spot for ages, owing perhaps to their perpetual verdure, which enables them constantly to cover and shelter, and thereby to ameliorate the soil. In the fields they flourish most luxuriantly, far surpassing cabbages, requiring much less manure and almost no attention. They are exceedingly less liable to be hurt by frost, and cattle eat them with great avidity. The compiler of these remarks has seen them growing on the north-east summit of Corstorphine hill near Edinburgh, without culture: the seed ripening, and young plants rising amidst fragments of broken rock, with scarcely a shadow of soil to nourish them. There indeed appears from experience to be no vegetable more congenial to our soil and climate than this, and it is not a little wonderful that it has not hitherto come into more extensive cultivation. It is an excellent smothering crop; it is fit to be used for feeding cattle both during summer and winter; during the former of these periods without injury to its growth, immense quantities of the open leaves may safely be removed from it for that purpose, and some of the species of it (of which there are many) are so hardy that no intensity of frost is injurious to them. It is particularly valuable for cows that are intended to give milk during the winter, and from its standing aloft it can without much difficulty be cut even in time of snow.

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The mode of cultivation is similar to that adopted for cabbages, excepting as already mentioned, that less manure and less care are necessary. Mr Young observed the cultivation of them in Flanders, and mentions it in these terms: * “ From *Orchies to Lille*—The kale, called here *choux de vache*, is common through this country ; it never cabbages, but yields a large produce of loose reddish leaves which the farmers give to their cows. The seed is sown in April, and they are transplanted in June or July, on to well-dunged land in rows, generally two feet by one foot ; I saw some fields of them in which they were planted at greater distances. They are kept clean by hoeing. They are reckoned excellent food for cows ; and the butter made from them is good, but not equal to that from carrots.”

Culture of
particular
Plants.

6. THE BEET, OR ROOT OF SCARCITY.

The *racine de disette*, or root of scarcity (*Betacica*), delights in a rich loamy land well dunged. It is directed to be sown in rows, or broad-cast, and as soon as the plants are of the size of a goose quill, to be transplanted in rows of 18 inches distance, and 18 inches apart one plant from the other: care must be taken in the sowing, to sow very thin, and to cover the seed, which lies in the ground about a month, an inch only. In transplanting, the root is not to be shortened, but the leaves cut at the top ; the plant is then to be planted with a setting stick, so that the upper part of the root shall appear about half an inch out of the ground ; this last precaution is very necessary to be attended to.

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the root of
scarcity.

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* *Travels*, vol. ii.

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particular
Plants.

These plants will strike root in twenty-four hours, and a man a little accustomed to planting will plant with ease 1800 or 2000 a-day. In the feed-bed, the plants, like all others, must be kept clear of weeds: when they are planted out, after once hoeing, they will take care of themselves, and suffocate every kind of weed near them.

The best time to sow the seed is from the beginning of March to the middle of April: it is, however, advised to continue sowing every month until the beginning of July, in order to have a succession of plants. Both leaves and roots have been extolled as excellent both for man and beast. This plant is said not to be liable, like the turnip, to be destroyed by insects; for no insect touches it: nor is it affected by excessive drought, or the changes of seasons. Horned cattle, horses, pigs, and poultry, are exceedingly fond of it when cut small. The leaves may be gathered every 12 or 15 days; they are from 30 to 40 inches long, by 22 to 25 inches broad. This plant is excellent for milch cows, when given to them in proper proportions, as it adds much to the quality as well as quantity of their milk; but care must be taken to proportion the leaves with their green food, otherwise it would abate the milk, and fatten them too much, it being of so exceeding a fattening quality. To put all these properties beyond doubt, however, further experiments are wanting.

We shall afterwards have occasion to consider both the qualities and the mode of cultivating this plant, when we come to treat of the cultivation of such vegetables, as are more properly articles of commerce.

SECT.

SECT. IV.

CULTURE OF GRASS.

The culture of grass is at once a difficult and an im-^{Importance}portant branch of the occupation or art of the hus-^{of the cul-}bandman. It is difficult; because the principles upon^{ture of} which it rests are not yet well understood, or are only^{grass} beginning to be so; and it is important, both on account of its direct value in feeding cattle, when well cultivated, and on account of its indirect worth, considered as a preparation for raising grain. According to the observation of Mr Young, he who has grass can at all times have corn; whereas, the reverse of the proposition is by no means true, on account of the preparation necessary to the production of valuable grass. A close and found turf is the best and the richest manure that has yet been discovered in nature, and when lands covered by it are broken up by the plough, they never fail for a time to produce valuable crops, whether of grain or of roots. A nation therefore which possesses a considerable quantity of excellent grass grounds, may be said to have bread, and consequently to have riches, laid up as in a storehouse, from which it can be drawn at pleasure. Practical husbandmen also frequently prefer pasture to arable lands, on account of the small degree of labour or hazard that attends it, and on account of the opportunity which it affords of laying out a great capital, with a reasonable prospect of profit. Men of property also are often induced to give it a pre-

**Culture of
Grass.** **ference, on account of the good condition in which it preserves their lands, the wealth of the tenants, which it procures for them, and the consequent ease with which a large estate may be managed.**

**Wherein
hay and pa-
sture differ.** **In the culture of grass an important distinction ought never to be lost sight of, between grass intended to be cut for hay, and that which is meant to be consumed by cattle upon the ground, which last is most properly pasture land. When a crop of hay is reaped, the soil is exhausted, in a certain degree, without any thing being restored to it; which is not the case when the cattle feed upon the ground. It ought to be observed, however, that a hay crop exhausts the soil very slightly, if it is cut extremely green, and before the grass plants have time to ripen their seeds. The degree in which the soil is exhausted, is found by experience to be proportioned to the maturity of the seeds of the grasses. Where hay crops, therefore, are raised, it is always necessary to dress the fields from time to time with manure.**

Independent of the difference between pasturage and hay crops resulting from the necessity of manure, it is to be remarked, that grass, which for some time has been cut for hay, is thereby rendered less fit to be used for pasturage; while on the contrary, when the land is pastured for some years, it becomes unfit to produce a good crop of hay: this arises from the pliable nature of the grass plants, and the habits which they are capable of acquiring. The grass plants propagate in two ways, by seed and by root. When they are allowed to stand for hay, and consequently to rise to maturity, nature seems to intrust the propagation of the different species to the seed which they produce. They grow up

**Grass how
propagated.**

up with strong stems, few in number, and the soil on which they rest retains a considerable degree of openness; whereas, when a field of grafs is kept low by being constantly, and rather severely pastured by cattle, so that no grafs seeds can be formed, the plants in this case propagate themselves by the root. A close matted turf is formed, which sends forth great numbers of more slender and delicate stems, which are incapable of rising up and forming a good crop of hay, though they afford a very sweet and grateful kind of pasturage for cattle; while, on the contrary, a field on which hay crops have usually been raised, when suddenly used for pasturing cattle, is unsuitable for the purpose; because the plants are few, and these, in the earliest stages of their growth, are of a lean, hungry, and coarse nature. To attempt, therefore, to internix these two ways of using grafs by cutting a field, and by pasturing it for a length of time on alternate years, is to adopt a sure plan for having neither good hay nor good pasture.

In the farther discussion of the subject, we shall consider, first, the modes which may with propriety be adopted for the improvement of grafs lands, independent of the use of the plough, or of flooding. Secondly, The mode of improving grafs where the aid of the plough is to be called in. Thirdly, We shall mention the particular grafs plants that ought in either case to be cultivated; and, lastly, We shall give an account of the mode of improving grafs lands by flooding them artificially with water.

Culture of
Grass.

1. *Improvement of Grass without the aid of the plough, or of watering.*

Good grass
not to be
broken up.

In many parts of Great Britain, more especially around the seats of country gentlemen, there are rich old pastures which have lasted for ages, without what is called fog, or the moss plants, having grown up or encroached upon the grasses. In such instances no improvement is necessary. Such lands are a treasure, of which the plough is the key. They will at any time produce immense crops of grain; but after having done so, it is very difficult speedily to restore the soil to its former state, or to renew the value of the pasture, which is very great. In speaking, therefore, of the improvement of pastures, we must be understood as treating of those of an inferior quality, or of what may be called *upland pastures*.

Draining.

For the improvement of upland pastures, then, the first step to be adopted on all those spots, where it may be necessary, consists of draining, of the various forms of practising which we have already given a full account. No general rule can be given for the kind of drains, which ought to be adopted. This principle, however, must undoubtedly be kept in view by the husbandman, as a rule of conduct common to all persons engaged in commercial employments, that he ought not to expend more money upon the soil in draining than it is capable of repaying; at the same time, he ought not, for the sake of avoiding present expence, to expose himself to a heavy annual expenditure in repairing his drains. Whether he is to use open or close drains, or what kind of open drains (if such are preferred) he is to adopt, must be determined by a due consideration of the quality of
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the soil, or the endurance of his own lease or interest in it. Culture of
Grass.

In cold upland situations, enclosing is often no less Enclosing. necessary than draining for the improvement of the pasture, and the one practice very conveniently accompanies the other where open drains are used; as the same ditches which clear the soil of water serve also for dividing the fields. In the situations now mentioned, enclosing is best performed by means of belts of planting, with the addition of clumps of hardy trees on the poorest eminences. In this way, the extent of pasture, though diminished by the space occupied by the timber, will usually remain sufficient in consequence of its amelioration, to afford liberal interest for the money laid out in enclosing, while at the same time the forest trees that are gradually rising, will afford a great addition to the worth of the property. The expence of enclosing and planting, however, as it is intended for the permanent benefit and amelioration of the soil, can only be undertaken by a proprietor; or by a tenant, in consequence of an allowance granted by the proprietor.

It is of considerable service to roll the turf of pasture Rolling. land in the months of February and March with a heavy wooden roller, always observing to do it in moist weather, that the roller may make an impression. This practice has a considerable tendency to fix the roots of the grass plants in the soil, which in some situations are otherwise apt to be cast out. When this last event happens, fog speedily springs up: The grasses decay, and the pasture becomes of little value, though such an event might easily have been prevented by the easy and unexpensive practice of rolling. The grass likewise is rendered sweeter by this husbandry, in consequence of
the

Culture of
Grass. the tendency which the pressure of the roller has by fixing, and, as it were, planting all the roots in the soil, to encourage a thick turf, or the growth of vast numbers of small and delicate plants.

To stock
with sheep. With a similar view, it is of great value towards the improvement of all poor pastures to stock them with sheep in preference to black cattle, and even rather to overstock them. Mr Young observes *, that it is the opinion of many eminent farmers, that nothing recruits poor soils so much as heartily feeding them with sheep for some years, provided the sheep are not folded from the land; and he himself has practised upon this principle with success. The effect of keeping a very full stock of sheep upon the land is, that they prevent any feed stems from rising to exhaust the soil, and thereby give to the grass plants, which they keep constantly pared down and bare by their close bite, a habit of mattenning or spreading their roots, so as to form a firm turf and a close growth of delicate grasses. This, like every other valuable practice, may no doubt be overdone, particularly during a very hot and dry summer; because, in such a season, if the land is much overstocked with sheep, they are under the necessity of biting so close, that they are apt to destroy the roots of the grass. In other respects, however, there is no doubt, that both by the mode of eating and by their dung, grass lands are greatly ameliorated by being fully stocked with these animals. As there are very few plants, which they do not eat when young (furze, broom, and heath, not excepted), they have a great tendency

* *Annals of Agriculture*, vol. xxvii.

dency to clear pasture land of almost all noxious weeds, and to encourage the exclusive production of grafs. Culture of
Grafs.

These ideas are well supported by the following passage in an essay * by the Rev. Arthur Young, in which, after giving lists of a few of the ordinary grasses to be afterwards noticed, he proceeds thus: " But here I must observe generally, that if the land thus laid to grafs be intended for sheep, it is not an object of very great consequence to sow only the finer grasses, as close feeding will make any grafs named in these lists fine, sweet, and productive; but this effect depends altogether on its being constantly fed close, that is, all seed-stems being prevented from rising. Every good farmer is sensible of the necessity of this with *rye-grass*, but most unaccountably does not extend a similar concern to other grasses. Above 200 acres under my management have been laid down chiefly for sheep, and I have stocked the fields so early in spring, and so thickly, as just to keep down the seed-stems: the *cock's-foot*, *oat-grass*, and *Yorkshire white*, with this management, have proved sweet feeding grasses, not at all rejected, even in fields where the flock had a choice. Several writers seem to have been very sensible of the consequence of close feeding.

" Mr Davis says, " 'The sweetness of the feed on the downs of Wilts depends much more on its being kept close, and eaten as fast as it shoots, than on any particular good quality of the grafs itself; for there are many downs that, when close fed, appear to be a very sweet pasture, but which, if suffered to run a year or

two

* *Communications to the Board of Agriculture*, vol. iii.

Culture of two without a full stock on them, will become so coarse,
 Grafs. , that sheep will almost as soon starve as eat the grafs.”
 (Wilts Report, p. 18.)

“ Upon Ben-Lomond, &c. the pasturing of sheep has evidently in the course of 20 years past improved the quality of the herbage, so as to raise grafs of a good species, and in very considerable abundance, where nothing formerly prevailed but bad kinds of grafs, and these in no great plenty; and the practice bids fair to banish heath from all the places that are pastured by sheep.

“ Lisle, who was the best writer on husbandry we had for many ages, remarks, (vol. ii. p. 79.), ‘ That there are poor soils which require a much longer time to grow a second inch than the first; and that consequently on such it is much more profitable to keep sheep than cattle.’ The writer of this essay, on first reading this passage, made this experiment on land of 12s. and 15s. an acre, clipping the plant with scissars, and carefully measuring and weighing the produce, and comparing it with neighbouring plants left to perfect the seed-stem: the superiority was proportioned to the times of cutting.” (Stirlingshire Report, p. 49.)

Sheep-feeding not only ameliorates by enriching the soil and fining the herbage, but also by destroying weeds. *Ragwort*, with which the bullock-grounds of Limerick are overrun for want of sheep, is much affected by them; and Mr Marshal gives an instance (York Economy, vol. ii. 128.) of a meadow, foul in the extreme, with knobweed, cured by pasturing it repeatedly in the spring with sheep.

“ But here a counter remark must be made, which is, that after a field has been pastured long with sheep, and
 close

close fed, it becomes unable to yield a growth of hay; the plants by being constantly cropped down acquire a dwarfish habit, however quick the growth in that early stage. There is a small field on this estate which has been under grafs time immemorial, and kept fed for the last 40 years at least, except one year in which it was mown, expecting a vast crop: the season was very favourable, but I was utterly disappointed, for the produce was small. I have known the same thing happen on enclosing an old common. In Scotland a similar remark has been made. "Two inclosures of the same soil were laid down together with grafs-seeds of the same kind; after two years hay the one was surrendered to pasture; from the other a crop of hay was taken every other year. After seven years absence the proprietor returned home, and wanting more hay, mowed both; and that which had been pastured gave the worst crop. Something like the same thing has been observed in Switzerland."

There are few pastures which may not be improved ^{Lime.} by the addition of quicklime in powder, spread out upon the surface. The moss plants are the greatest enemies of the grasses, and as quicklime utterly consumes and destroys them, it performs two services to the pasture, or rather to the grasses which form the pasture. In the first place, it destroys the most dangerous rival of the grasses; and secondly, it converts that rival, or the fog, into a valuable manure for the amelioration of the soil. An example of successful improvement in this way is stated in the Annals of Agriculture *, as performed by a county member of parliament.

"About

* Vol. xxiv.

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“ About eighteen years ago, I took about eighty Scots acres of land that had been arable, but left to graze for four or five years, of which, above twenty were of a very bad soil, part of the rest only middling, and about two-thirds of a good natural light soil; but the whole had been left out in a very bad order by the tenant. I inclosed the whole in one field by a very good dry stone wall, four feet and a half high, besides two rows of turf on the top. I gave it at the rate of about 300 Winchester bushels of slaked lime to the Scotch acre on the sward in summer, and did nothing else in the way of improvement or of cleaning it.

“ The expence of inclosing and liming of the whole amounted to about 320*l*.

“ Ever since I have let it for summer pasture only by auction; at first it let for less than 16*l*.; the rent rose gradually. About six or seven years ago it let for about 40*l*.; for the two last years between 50*l*. and 53*l*. per annum; and this year (1795) it let for 75*l*.

“ I suspect this extraordinary rent has been owing to a competition; but I certainly reckon that it will produce a fair good rent of about 60*l*. or perhaps more. The Scots acre is to the English as 1270 to 1000.

“ The tenants who have hired it have applied it mostly to feeding cattle, and perhaps a few horses; never to feeding sheep. By the information I could get it was sufficient to feed well during the summer sixty head of black cattle.

“ The importance of liming does not only appear from this trial upon worn-out and exhausted land, for I have remarked the same great effect on soils in much better heart; for instance, in the division of farms that were many years ago the *infield* parts, and which hav-

ing

ing for many years received all the dung of the farm, ^{Culture of} were in good condition when laid to grafs, though by ^{Grafs.} no means clean: the limed parts of these have such a superiority that the good effect could not be doubted.

“ I have found, by a number of experiments, that the good effects of mixing lime with tolerable earth, taken off the surface, or from ponds, ditches, or quagmires, have been much superior to using it alone. I mix in general about double the quantity of earth to that of lime; but the proportion which is sufficient to saturate the earth varies, but is easily known by the workmen themselves from experience. If the land is moss it should be harrowed, after frost, before the earth and lime are laid on it; this destroys the moss completely. It is well known that all land should be perfectly drained before calcareous earth is applied to it.”

Paring and burning ^{is} ^{likewise a valuable improvement.} ^{It may either be applied partially or generally.} ^{the ground is overrun with bushes or rushes, it will be of great advantage to the land to grub them up towards the latter part of summer, and after they are dried to burn them, and spread the ashes over the ground just before the autumnal rains, at which time the surface of the land should be levelled and sown with grafs-seeds, which will come up in a short time, and make good grafs the following spring. So also when the land is full of mole or ant-hills, these should be pared off, and either burnt for the ashes, or spread immediately on the ground where they are pared off, observing to sow the bare patches with grafs-seed just as the autumnal rains begin.} ^{Paring or burning.}

That paring and burning may be advantageously applied over the whole surface of the soil cannot

**Culture of
Grafts.** be doubted, providing always that proper grafts-seeds are sown. In the Annals of Agriculture (vol. xxxiv.) the following instance of this practice is recorded : “ Thomas Bradford Esq. now of Ashdown park, near Grinstead in Suffex, when he lived near Doncaster some years ago, pared and burned a poor worn-out ley, spread the ashes, and harrowed in white clover, rye-grass, rib-grass, and trefoil, without any ploughing ; and it has ever since been a very fine meadow. This is a remarkable experiment that deserves much attention, for it is applicable to cases in which such management would prove uncommonly convenient. It is, where suitable, the cheapest of all improvements.”

2. *Of the Culture of Grafts by the aid of the Plough.*

Considerable information has been obtained, or rather diffused, upon this subject in consequence of the premiums offered by the Board of Agriculture for Essays upon the means of converting grafts lands into tillage without exhausting the soil, and of restoring them to permanent grafts again in an improved, or at least in an uninjured state.

**Reasons for
breaking
up grafts.** Grafts or pasture lands are usually brought under the plough for one of two reasons. On those rich soils where the pasture is permanently good, and where the close turf continues to produce valuable grasses without intermixture of fog or other coarse plants, a landlord is sometimes tempted to break up the soil for the sake of the rich crops of grain which the vegetable mould which has for years been accumulating at the surface enables it for a certain time to yield. In such a case, however, unless great care is used in preserving or in restoring to the soil what it has lost by this treatment, the proprietor

proprietor is extremely apt to find that he has been squeez- Culture of
Grass.
ing the orange, of which he retains only the empty rind.

Less valuable pastures are frequently broken up, and indeed ought to be so, for their improvement. When, in consequence of the bleakness of the climate, or the exhausted state in which the land was formerly laid down to pasture, the moss plants have prevailed over the grasses, or when the lands have come to be covered with fern, rushes, and ant-hills, it is usually advantageous to subject them for some time to the plough, ~~that an~~ opportunity may be afforded of permanently ameliorating the pasture.

To prepare lands for grass, the same rules must be Preparation
of arable
lands for
grass.
attended to and observed that are necessary for preparing them to yield rich crops of grain, that is to say, the lands must be cleaned or freed of weeds, and they must be brought into good heart, or well manured. To cultivate any particular plant, the first and most necessary step to be taken, undoubtedly, is to remove every rival from the soil, that it may be able alone to occupy its whole powers. This is no less necessary, if we wish to rear particular grasses, than if we wish to obtain crops of certain kinds of grain. That the land which is to be converted into pasture ought to be in good condition, is perhaps still more obvious, as it is in vain to expect that valuable plants will grow without nourishment. It is true, that in a good climate, if exhausted land is left to itself, nature will gradually produce some sort of improvement on its surface. Plants of some kind or other will spring up, and by the rotting of their leaves and roots, will, in time, produce a portion of vegetable mould, which may serve to nourish some of the grasses, or if torn up by the
E 2 plough,

Culture of
Grafs.

plough, to give for a year or two good crops of graitt. It is this circumstance which has probably introduced a considerable negligence of conduct on the part of many farmers, with regard to the cultivation of grafs. Such conduct, however, ought to be carefully avoided by every true agriculturist, that is, by every man who is endeavouring to derive from the soil the highest profit which it is capable of yielding in a short time.

Rotation
of crops.

The great art of cleaning a soil, and at the same time of bringing it into good heart by providing abundance of manure, consists of subjecting it to a judicious previous rotation or course of crops. Upon this subject, which is extremely important, we have already made some remarks, when treating of the proper modes of bringing land into culture from a state of nature. The general rule is, that excepting upon a very stiff clay, which from the fear of poaching may not admit of such a practice, the best of all immediate preparations for grafs, consists of a crop of turnips consumed by cattle upon the field; as, in this way, if the turnips are properly cultivated, the land will be at once cleaned and manured. This arrangement is uncommonly advantageous where lands have been broken up to ameliorate a poor pasture, because turnips scarcely fail to succeed wherever they enjoy a new soil, or the manure afforded by fresh turf; in other cases, artificial manure is necessary to bring forward a heavy crop, without which the preparation for grafs will be incomplete; as a scanty crop, affording little food for cattle, will not enable them in their turn to improve the soil by dung. In this case, the best mode is to repeat the turnip crop on the succeeding year. Where there is abundance of manure, however, but not otherwise, a crop of cabbages,

ges, treated in the same manner, is perhaps still more valuable than turnips. It unites every advantage of the drill husbandry in cleaning the land, with the benefit which the soil derives from a shading or smothering crop, concluding with the production of abundance of manure.

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Grass.

On clay land the management should be different. The soil should be amply manured in autumn or spring, in the driest weather, when carting can be performed without injury. One ploughing ought to be given in ~~autumn~~ and three or four more in summer previously to August, when the seeds are to be sown.

With regard to the more immediate preparation of land for grass seeds, it is a celebrated question, about which various opinions have been entertained and much written, Whether grass seeds ought to be sown along with a crop of corn in spring, or after a summer fallow in August without corn? The Rev. Mr Arthur Young states the subject in the following terms*: "Much has been written on the comparison of these seasons, and whether with corn in spring, or without it in August. But Mr Lyster of Bawtrey compared them, and found the latter much the better. Mr Dickson of Belford made a comparative experiment, but all in the spring: Four acres with grasses alone, on pease and buck-wheat ploughed in the preceding autumn; five acres with barley, and five the seeds alone without either corn or manure. The two divisions sown alone were overrun with chickweed, and would have been choked, but a dairy of cows ate it. From that time,

Grasses
sown with
or without
corn.

Culture of
Grass. for seven years, no difference perceptible between the three divisions. The earl of Holderness laid down large tracts of land, both at Hornby Castle and Sion, and found by experiments, that the seeds answered best when sown alone.

“ Other authorities (continues this writer) might be quoted, but the fact is, that the seeds will succeed almost equally well in either method ; though if I did give the preference, it should be to August sowings without corn ; but the success I have witnessed in both seasons does not allow any positive opinion. Moor and mountains are an exception. In such situations snows come too early to venture such sowings ; on such I do not think that grass-seeds should ever be sown in autumn, nor ventured later than the first week in August : but the better season is the spring ; and with oats, not for a crop of corn, but following the too general advice of an Italian author, to mow it, before the seeds ripen, either for soiling or for hay.”

On the other hand, the subject is thus treated in an Essay addressed to the Board of Agriculture, by the Rev. H. J. Clore *. “ A friend of mine wished to procure a good meadow or pasture around his house ; he fallowed the land for barley ; but the spring proving wet, and the soil being a strong loam, he could only put half of it in order for that crop, which was sown, and laid with clover and rye-grass. The other part was fallowed and sown in August with the sweepings of hay chambers, as I have recommended. The barley was a good crop, and the clover and rye-grass were probably equal
to

* *Communications*, vol. iii.

to the first year's cut of hay. The second year the artificial grasses began to fail; worse the third, fourth, and fifth: the sixth year, after having received two dressings, the spontaneous product of the soil began to give a fleece over the surface of the land. About two years after these lands were sown, I saw this field, when the part sown in August was worth at least 15s. per acre more than the part which had been sown with artificial grasses in the barley. Thus, from actual experiments, numbers of which I could adduce, it appears that sowing the dressings of hay chambers in August, is preferable to sowing artificial grasses in the spring with any crop of corn. Suppose the corn worth 5l. per acre, the difference of the produce of hay or seed in the second, third, fourth, and fifth years, would more than counterbalance this; and the proprietor would find a permanent improvement in his land of from 15s. to 20s. per acre. "Sowing rubbish in August is not of so great importance as in the spring. In the former season all the annual seeds vegetate, and if the beginning of the winter be mild, they will blossom; but they cannot perfect their seed, and the first frost destroys them. If sown in the spring, they vegetate, blossom, perfect, and shed their seeds, and thus stock the land with noxious weeds."

Upon this question of sowing grass seeds with or without a crop of corn, the fact appears to stand thus: That grass seeds will undoubtedly thrive under a corn crop, especially barley, which is soonest removed from the ground, and comes up with a slender stalk so as not to overshadow the young grass plants; but it ought to be remembered, that every corn crop, which is suffered to bring its seeds to maturity, robs the soil of a great portion

Culture of
Grass.

Opinion on
the subject.

Culture of
Grass. tion of its fertilizing powers. Whatever therefore is gained by the crop of corn, is in some measure lost by the succeeding crop of grass. The last quoted writer remarks, that "should it be thought proper to sow the seeds with any corn, barley must have the preference. If sown with oats, and the land prepared as it should be, viz. in high tilth and order, the oats will be so luxuriant as to smother and destroy the young plants." Lands intended for grass or meadow cannot be in too high a state of cultivation. The permanent improvement in the intrinsic value of the land will abundantly repay almost any expence. To improve the soil with this view, and then to exhaust it by a crop of corn at the time of sowing the seeds, appears to me a sure method of counteracting the very object in view."

Whether grain, therefore, is or is not to be sown with grass-seeds, will, at least upon open and light soils, be a question, the answer to which must chiefly depend upon the state in which the land actually is. In the neighbourhood of a city, and where dung can be procured in abundance, it will be prudent, in this as in every other case, to sacrifice manure, in place of sacrificing time and labour, by allowing the soil to remain fallow.

Autumnal
manage-
ment.

Whether grass-seeds be sown in the spring along with corn, or in August after a fallow, the autumnal management will be equally important. All trampling by cattle and horses is pernicious: for the soil, after a crop of corn, or after the tillage of a fallow, is very tender, and easily affected by every impression; it is also bad to feed the plants, as has been found by experience. The safe way is to keep every thing out through both autumn and winter. The profit of feeding is absolutely

by nothing; for the pasturage in the spring for sheep is of far more value, by reason of not eating it in autumn: at the former season it affords a most valuable and very early bite for ewes and lambs. Culture of
Grass.

When permanent pasture is intended, the subject of its treatment, during the first crop, has already in some measure been discussed. A crop of hay ought by no means to be taken. If the grass, however, is mown, it ought at least to be done early, that the soil may not be exhausted by the grass running to seed. The proper mode of treatment during the first year, consists of feeding with sheep, unless very great quantities indeed of the best manure can be afforded to be spread upon the surface after the crop of hay. At the same time, the number of sheep should not be so great nor kept so long, especially in a dry season, as to endanger the plants, by being nibbled too close. "If bents rise," says the Rev. Mr Arthur Young, in the Essay already quoted, "as they will do, let them be swept with a scythe before any of them feed, unless the plants be evidently too thin on the ground: In that case, the seed falling may do more good by raising fresh plants, than harm to those which yield the seed. Though I have little doubt that feeding is the right management, yet it is not to be concluded, that with mowing, the grass will not succeed; Lord Rockingham's new leys, viewed in the autumn of the first year, were, by description, among the finest that have been seen; they were matured, however, the autumn after sowing, which is admirable management, provided the soil be found and the season very dry. First years
treatment.

"But it is not only the first year that sheep-feeding is the best management for a new ley; there is no necessity

Culture of necessity of continuing it longer ; but I have had some
Grafs. fields under my care, which succeeded well in feeding
Importance four, five, and even six years ; and, in general, it may
of feeding be laid down as a rule, that the more the land is sheep-
with sheep. fed, the more it will be improved ; and especially if it
 be ever to be ploughed again for corn. But when sheep-
 feeding enclosures are mentioned, it is understood, that
 the sheep are not to be removed from such fields to be
 folded elsewhere ; a ruinous, impoverishing, unnecessary
 system, of which the farmers are too fond, as they are
 of every way of robbing grafs to favour corn."

Manage-
ment if the
crop fail.

Should a total failure of the grafs crop take place
 from any unforeseen cause, the best conduct, adds the
 same author, will be in " fields that were sown in the
 spring, to clean the corn as early as possible, and plough-
 ing once to harrow in fresh seeds immediately : these
 will succeed very well if they be got in during the
 month of August ; the sooner the better ; and in this
 case, the land should be very well rolled in October in
 a dry season. If the failure happen on land sown in
 August, it should have three earths in dry weather in
 the spring, and grafs-seeds re-sown with buck-wheat in
 May. It is not a crop for clays and wet loams ; but I
 have known it succeed well in a dry summer : should
 the season be wet it will give little feed, and should be
 mown when in blossom for foiling cows. It is an ame-
 liorating plant never exhausting any soil ; and therefore
 preserves in the land the fertility gained by the opera-
 tions previous to the former sowing. And I may here
 generally observe, that grafs-seeds of all sorts and on all
 soils, never succeed better than with buck-wheat, of
 which not more than one bushel an acre should be
 sown. There is a district in Norfolk where buck-wheat

is highly valued for this object. It is a profitable article of cultivation on the very poorest barren sands." Culture of
Grass.

3. *Of the particular Grasses that ought to be Cultivated.*

Culmiferous grasses may be divided into two general classes for the purposes of the farmer, that it might be of use for him to attend to : viz. 1st, Those which, like the common annual kinds of corn, run chiefly to seed-stalks ; the leaves gradually decaying as they advance towards perfection, and becoming totally withered or falling off entirely when the seeds are ripe. Rye-grass belongs to this class in the strictest sense. To it likewise may be assigned the vernal grass, dogs-tail grass, and fine bent grass. 2dly, Those whose leaves continue to advance even after the seed-stalks are formed, and retain their verdure and succulence during the whole season ; as is the case with the fescue and poa tribes of grasses, whose leaves are as green and succulent when the seeds are ripe and the flower-stalks fading, as at any other time.

" It is wonderful, Mr Stillingfleet * remarks, to see how long mankind have neglected to make a proper advantage of plants of such importance, and which, in almost every country, are the chief food of cattle. The farmer, for want of distinguishing and selecting grasses for feed, fills his pastures either with weeds, or bad or improper grasses ; when, by making a right choice, after some trials, he might be sure of the best grass, and in the greatest abundance that his land admits of. At present, if a farmer wants to lay down his

* *Traacts relating to Nat. Hist. &c.*

Culture of
Grass. — his land to grass, what does he do? he either takes his seeds indiscriminately from his own foul hay rack, or sends to his next neighbour for a supply. By this means, besides a certain mixture of all sorts of rubbish, which must necessarily happen, if he chances to have a large proportion of good seeds, it is not unlikely but that what he intends for dry land may come from moist, where it grew naturally, and the contrary. This is such a slovenly method of proceeding, as one would think could not possibly prevail universally: yet this is the case as to all grasses, except the darnel-grass, ~~and~~ what is known in some few counties by the name of the *Suffolk-grass*; and this latter instance is owing, I believe, more to the soil than any care of the husbandman. Now, would the farmer be at the pains of separating once in his life half a pint or a pint of the different kinds of grass seeds, and take care to sow them separately, in a very little time he would have wherewithal to stock his farm properly, according to the nature of each soil, and might at the same time spread these seeds separately over the nation, by supplying the seed shops. The number of grasses fit for the farmer is, I believe, small; perhaps half a dozen or half a score are all he need to cultivate; and how small the trouble would be of such a task, and how great the benefit, must be obvious to every one at first sight. Would not any one be looked on as wild who should sow wheat, barley, oats, rye, pease, beans, vetches, buck-wheat, turnips, and weeds of all sorts together? yet how is it much less absurd to do what is equivalent in relation to grasses? Does it not import the farmer to have good hay and grass in plenty? and will cattle thrive equally on all sorts of food? We know

know the contrary. Horses will scarcely eat hay that will do well enough for oxen and cows. Sheep are particularly fond of one sort of grass, and fatten upon it faster than any other, in Sweden, if we may give credit to Linnæus. And may they not do the same in Britain? How shall we know till we have tried?"

Culture of
Grass.

Notwithstanding what is above stated, concerning the impropriety of sowing grass seeds indiscriminately, this practice has its advocates. The Rev. Mr Close, in the essay above-quoted, remarks that "many object to sowing such rubbish as the sweepings of hay chambers produce; and I wish most sincerely any method could be devised for procuring clean seeds of our best and natural meadow grasses. It is a great desideratum, and premiums to encourage agriculturists to sow seeds of the fescues and poas, &c. and for the largest quantity of land sown with these seeds, and kept distinct, might be of infinite service. Until this can be effected, the above plan appears to me the most eligible. It certainly has been crowned with the greatest success." This opinion, however proceeds only upon the supposition that proper grass-seeds cannot be obtained, a difficulty or rather an evil which is daily declining.

The grasses commonly sown for pasture, for hay, or to cut green for cattle, are red clover, white clover, yellow clover, rye-grass, rib-grass, sainfoin, lucerne, &c.

Kinds of
grasses com-
monly
sown.

Red clover is of all the most proper to be cut green for summer food, and its great value as a preparation for wheat has already been noticed. It is a biennial plant when suffered to perfect its seed; but when cut green, it will last three years, and in a dry soil longer. At the same time the safest course is to let it stand but

Red clover.

Culture of
Grass.

but a single year: if the second year's crop happen to be scanty, it proves, like a bad crop of pease, a great encourager of weeds by the shelter it affords them.

Here, as in all other crops, the goodness of seed is of importance. Choose plump seed of a purple colour, because it takes on that colour when ripe. It is red when hurt in the drying, and of a faint colour when unripe.

Red clover is luxuriant upon a rich soil, whether clay, loam, or gravel: it will grow even upon a moor, when properly cultivated. A wet soil is its only bane; for there it does not thrive.

Culture of
red clover.

To have red clover in perfection, weeds must be extirpated, and stones taken off. The mould ought to be made as fine as harrowing can make it; and the surface be smoothed with a light roller, if not sufficiently smooth without it. This gives opportunity for distributing the seed evenly: which must be covered by a small harrow with teeth no larger than those of a garden rake, three inches long, and six inches asunder. In harrowing, the man should walk behind with a rope in his hand fixed to the back part of the harrow, ready to disentangle it from stones, clods, turnip or cabbage roots, which would trail the seed, and displace it.

Nature has not determined any precise depth for the seed of red clover more than of other seed. It will grow vigorously when two inches deep, and it will grow when barely covered. Half an inch may be reckoned the most advantageous position in clay soil, a whole inch in what is light or loose. It is a vulgar error, that small seed ought to be sparingly covered. Missed
by

by that error, farmers commonly cover their clover feed with a bushy branch of thorn; which not only covers it unequally, but leaves part on the surface to wither in the air. Culture of
Grass.

- The proper season for sowing red clover, is from the middle of April to the middle of May. It will spring from the first of March to the end of August; but such liberty ought not to be taken except from necessity.

There cannot be a greater blunder in husbandry than to be sparing of seed. Speculative writers talk of sowing an acre with four pounds. That quantity of seed, say they, will fill an acre with plants as thick as they ought to stand. This rule may be admitted where grain is the object; but it will not answer with respect to grass. Grass feed cannot be sown too thick: the plants shelter one another; they retain all the dew; and they must push upward, having no room laterally. Observe the place where a sack of pease, or of other grain, has been set down for sowing: the seed dropt there accidentally grows more quickly than in the rest of the field sown thin out of hand. A young plant of clover, or of sainfoin, according to Tull, may be raised to a great size where it has room; but the field will not produce half the quantity. When red clover is sown for cutting green, there ought not to be less than 24 pounds to an acre. A field of clover is seldom too thick: the smaller a stem be, the more acceptable it is to cattle. It is often too thin; and when so, the stems tend to wood. Thick sowing.

Grain may be sown more safely with red clover than with almost any other grass; and the most proper grain has been found to be flax. The soil must be highly Of sowing
clover with
grain.

Culture of highly cultivated for flax as well as for red clover.
Grass.

The proper season of sowing is the same for both; the leaves of flax being very small, admit of free circulation of air; and flax being an early crop, is removed so early as to give the clover time for growing. In a rich soil it has grown so fast, as to afford a good cutting that very year. Next to flax, barley is the best companion to clover. The soil must be loose and free for barley; and so it ought to be for clover: the season of sowing is the same; and the clover is well established in the ground before it is over-topped by the barley. At the same time, barley commonly is sooner cut than either oats or wheat. In a word, barley is rather a nurse than a step-mother to clover during its infancy. When clover is sown in spring upon wheat, the soil which has lain five or six months without being stirred, is an improper bed for it; and the wheat, being in the vigour of growth, overtops it from the beginning. It cannot be sown along with oats, because of the hazard of frost; and when sown as usual among the oats three inches high, it is overtopped, and never enjoys free air till the oats be cut. Add, that where oats are sown upon the winter furrow, the soil is rendered as hard as when under wheat.—Red clover is sometimes sown by itself without other grain: but this method, beside losing a crop, is not salutary; because clover in its infant state requires shelter.

As to the quantity of grain proper to be sown with clover: In a rich soil well pulverized, a peck of barley on an English acre is all that ought to be ventured; but there is not much soil in Scotland so rich. Two Linlithgow firloths make the proper quantity for an acre that produces commonly six bolls of barley; half

a firlof for what produces nine bolls. To thofe who are governed by cuftom, fo fmall a quantity will be thought ridiculous. Let them only confider, that a rich foil, in perfect good order, will from a fingle feed of barley produce 20 or 30 vigorous ftems. People may flatter themfelves with the remedy of cutting barley green for food, if it happen to opprefs the clover. This is an excellent remedy in a field of an acre or two; but the cutting an extenfive field for food muft be flow; and while one part is cutting, the clover is fmothered in other parts.

Mr Clofe, whofe effay has been already quoted, ftrongly recommends the fowing of barley in drills when clover is intended to be raifed along with it. He thus describes his mode of proceeding and its advantages: "From many years practice I am convinced that the moft certain method of obtaining a crop of clover, or other graffes, without injury to the barley, is to fow the lands previous to the laft horfe-hoeing. The advantages of this method I have experienced by long practice, and they feem confirmed by theory. The barley being twice horfe or hand hoed previous to fowing the feeds, will not only be clear from annual weeds, but a fine tilth will be obtained for the feeds; the blades of corn meeting over the intervals, will protect the young plants from the depredations of the fly, and from the fcorching fun; the moifture of every dew will be retained under the fhade of the corn; and the feeds, by being fown a month or fix weeks after the barley, will never exhaust themfelves too much the firft fummer, nor rife fo high as to interfere with harvefting the barley. In a moift feafon, when the feeds are fown early with the barley, the land is frequently full of an-

Culture of
Grass.

Clover fown
on drilled
barley.

Culture of Grass. { annual weeds; the young plants of clover are taken off by the fly, and if they flourish, expend themselves so much, that when you expect a full and first crop of clover, you have something like a second year's cut; and many fields of barley have been rendered useless for all the purposes of malting, by having so large a portion of rich succulent clover in the crop as to prevent their being harvested."

**Clover seed
how col-
lected.**

When red clover is intended for seed, the ground ought to be cleared of weeds, were it for no other purpose than that the seed cannot otherwise be preserved pure: what weeds escape the plough ought to be taken out by the hand. In England, when a crop of seed is intended, the clover is always first cut for hay. This appears to be done, as in fruit trees, to check the growth of the wood, in order to encourage the fruit. This practice will not answer in Scotland, as the seed would often be too late for ripening. It would do better to eat the clover with sheep till the middle of May, which would allow the seed to ripen. The seed is ripe when, upon rubbing it between the hands, it parts readily from the husk. Then apply the scythe, spread the crop thin, and turn it carefully. When perfectly dry, take the first opportunity of a hot day for thrashing it on boards covered with a coarse sheet. Another way, less subject to risk, is to stack the dry hay, and to thrash it in the end of April. After the first thrashing, expose the husks to the sun, and thrash them over and over till no seed remain. Nothing is more efficacious than a hot sun to make the husk part with its seed; in which view it may be exposed to the sun by parcels, an hour or two before the flail is applied.

The

The following mode of collecting red clover feed is described by Ezra L'Hommedieu, Esq. of New York *, <sup>Culture of
Grass.</sup> as practised in Suffolk county, North America, and deserves notice. "When you perceive about one half of the field to have changed its colour by the drying of the clover heads, you then begin to collect them, which is <sup>Clover feed
how col-
lected in
America.</sup> done by a machine invented at Brookhaven in Suffolk county: It is drawn by a horse, and guided by a man or boy, who will collect from the field by this means the heads of clover growing on five acres in one day: the price of collecting is 2s. 6d. per acre. This machine is of a simple construction; it is nothing more than an open box of about four feet square at the bottom, and about two feet high on three sides. One part, which we may call the fore-part, is open; on this part are fixed fingers, similar to the fingers of a cradle, about three feet long, and so near together as to break off the heads from the clover stocks which are taken between those fingers: the heads are thrown back into the box as the horse walks on. The box is fixed on an axle-tree, supported by two small wheels of about two feet diameter. Two handles are fixed to the box behind, by which the man or boy, at the same time he guides the horse, lowers or raises the fingers of the machine, so as to take off all the heads from the grass: as often as the box gets full of heads they are thrown out, and the horse goes on again.

"Another instrument is used for collecting hay-feed, which is called a *cradle*; it is made of a piece of oak-board of about eighteen inches long and ten broad;

F 2

about

* *Annals of Agriculture*, vol. xx.

**Culture of
Grass.** about nine inches of this board, which we may call the fore part, is sawed into fingers of about nine inches long; a handle is fixed into the board, on the back part, almost at right angles, inclining towards the fingers; a cloth is put round the back part of the board, which is cut rounding and raised on the handle; this collects or keeps from scattering the heads which are struck off from the grass by this cradle; different sizes are used; less than the above described for women and children, who collect large quantities in this way.

“All the heads of clover, in what manner soever collected, ought to be put into small heaps or cocks in the field, and there exposed, that the husk may rot, (which generally takes about three weeks in Suffolk county), otherwise it will be very difficult to get out the seed. Some attention ought to be paid to these heaps, or cocks, lest they should rot too much next to the ground. It will sometimes be necessary, in case of much rain, to turn the heap by rubbing the heads in your hand; it may easily be perceived when the husk is sufficiently rotten and dry: they are carted into the barn, and whenever it is found convenient, the seed is thrashed out on the barn-floor, and cleaned with a wire-riddle.”

White
clover.

White or Dutch clover (*trifolium repens*) has hitherto been the chief dependence of those who have laid down land permanently to grass, and is upon the whole the best kind of grass that can be relied on, for all rich or dry loams, sands, &c. and also for rich clays that have been properly drained, and peats; but on poor wet loams and clays it speedily wears out, and gives way to various noxious plants, particularly the coarse water-grass (*agrostis stolonifera*). There exists not perhaps a better

ter test of the goodness of a soil than the circumstance of its producing this plant spontaneously when left unploughed. Whatever grafs-seeds are sown for pasture, therefore, white clover ought to form a part. When close fed it has great sweetness for all kinds of stock; though when this is neglected, this, like several other grasses, would seem to become less valuable for sheep: for it will be observed, that for the preservation of the various species of plants, nature has provided that their seeds or flowering stems should be unacceptable to this otherwise close-biting animal.

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Grass.

White clover is much improved by the ground being rolled at proper periods after the grafs is up; for as this plant puts out roots from every joint of the branches which are near the ground, so by pressing down the stalks the roots mat so closely together as to form a sward that covers the whole surface of the ground, and forms a thick green carpet of great power in resisting drought; hence, if we examine in a very dry summer the common pastures, we shall find that the patches of this white honeyfuckle grafs exhibit the only instances of verdure remaining in the fields.

White clover intended for seed may be managed in Scotland in the manner already directed for red clover.

Rye-grass (*lolium perenne*) is for many purposes a very valuable kind of grafs; it will flourish on any land except stiff clay, and will grow even on that. Upon rich light soils it is not only a good spring-grass, but the best kind of it, if properly managed by due mixtures of other grasses, suits well for permanent pastures.

Rye-grass has a greater resemblance to grain than almost any of the other grasses; if suffered to ripen its seed, and thereafter cut for hay, it is an exhausting or

impoverishing

**Culture of
Grass.** **impoverishing crop.** Like oats or barley, if cut green before the seed forms, it will afford various other cuttings during the same season, in proportion to the favourableness of the weather; but, like them, if its seed is once formed, its growth is stopped for that year. When instead of being cut for hay it is close fed, it puts out a great variety of roots and small stems, and forms close and delicate herbage.

In several English counties they complain that the quality of rye-grass has of late very much degenerated. The original kind produced a white stalk and a white seed, and is a perennial grass. The degenerate kind has a purple stalk, and a blackish seed, and has almost become an annual. **Mr Peacy's
rye-grass.** Mr Peacy of North Leach, in Wilts, has gained much profit from selecting and selling the true sort to the farmers of several counties. Its excellencies are, superior luxuriance in autumn, a longer duration in the foil, and that if sowed at Michaelmas it will grow all winter.

**Qualities of
rye-grass.** Dr Campbell of Lancaster, in the essay already quoted, speaks thus of the qualities of rye-grass. "Upon looking back at the different opinions that have been given of this grass, it is conceived, that they may be naturally accounted for. It has been tried in some situations, and found not to give a thick well-connected sward. Rye-grass is natural only to good soils, or those in a fertile state; for, however it may be found accidentally in those of a contrary description, it will be only where the land has been enriched by dung or other manure, casually dropped. It comes up spontaneously for the most part by the road sides, or near the gate of a pasture field where the cattle are accustomed to wait. The present summer a field was observed

served to be so full of rye-grass, that, knowing none had been sown in the country, it became a question of curiosity to discover what circumstances had occasioned it. Upon inquiry, it turned out that a large quantity of cattle for a neighbouring fair, had been folded there a night, who had covered the field with their dung; whence the tendency to produce rye-grass."

"When land is in a proper state of manure, rye-grass, united with white clover, will form a perfect sward the latter end of the second year after it is sown. I have a particular field of about five acres, that was sown with these two grasses only, that is more perfectly grassed over than others which had the addition of trefoil and rib-grass, and which were sown at the same time.

"On converting rye-grass into hay, it is necessary to cut it at a period previous to its being so ripe, as to have perfected its seed, and changed to a yellow colour; for in this case a great part of the juices of the plant, which constitute a principal part of the nutriment it is to afford, will be converted into a species of straw, and its nutritive properties be proportionally diminished.

"When it is made into hay, persons not acquainted with its qualities are apt to object to its apparent coarseness, which proceeds from its consisting almost entirely of flowering stems, the rye-grass having comparatively a smaller proportion of leaves than any other grass. Whether this be a defect or a merit, will depend upon a solution of this question: Do the stems and flowering parts of grass, or the leaves taken, weight for weight, contain the greater proportion of nutriment? It does not appear that this has been determined by experiments instituted for the purpose; but it seems probable from the stems being so much sweeter than the

Culture of leaves, (which is particularly perceptible upon chewing
Grafts. them when about half dry), and from those vegetables which contain much saccharine matter being particularly nutritious, that the greater proportional quantity of nutriment will be found to reside in the stalks; and if so, the advantages of rye-grafs will be decisive.

“ But, however this may be, it is certain, that, supposing wet weather comes on during the process of hay-making, the first part of the grafs that decays is the leaf, which soon becomes yellow, and then black; losing all pretensions to nutritive properties; in which case it is evident that almost the whole nutriment contained in the hay must reside exclusively in the flowering stalks. Rye-grafs, then, has in unfavourable hay seasons an advantage over all others, inasmuch, as from having fewer leaves, it is not so apt to be injured by a continuance of rain, and it is besides, when in the cocks, more accessible to the air and wind, from lying more open and light; and consequently not so apt to heat and mould as other grasses in similar situations and seasons.

“ It certainly possesses the following valuable properties: 1. That there are few grasses so early in the spring. 2. That there are none better relished by cattle, nor more nutritive. 3. That it has the power of resisting bad weather, in ticklish hay seasons, in a greater degree than other grasses. 4. That there is a greater facility in collecting its seed than that of any other grafs.

“ The prejudices against it appear to have arisen, 1. From its having been sown in land not capable of producing a full crop of any good vegetable. 2. From allowing it to shoot up so far as to have formed the seed in the flowering stalk, before cattle have been turned in-

to pasture, or that it has been cut for hay. Rye-grass appears to partake more of the nature of grain than any other grass. Hence, when it has perfected its seeds, it shoots out no more stalks and but few leaves that season, as Lord Kaimes has justly observed. Hence, it is necessary to turn cattle into a field of this grass early in the spring, and to keep it well under by a sufficient quantity of stock; in which case it will continue to put out fresh flowering stalks and leaves during the whole season.

3. The hay, for the reason just assigned, should be cut before it becomes a mere straw. Common hay-grass, being composed of grass in various stages of growth and ripeness, admits of a greater latitude than a field of rye-grass, because many of them will generally be in a proper state for cutting, although others may have passed their prime."

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Grass.

No plant ought to be mixed with rye-grass that is intended for seed. In Scotland, much rye-grass seed is hurt by transgressing that rule. The seed is ripe when it parts easily with the hulk. The yellowness of the stem is another indication of its ripeness; in which particular it resembles oats, barley, and other culmiferous plants. The best manner to manage a crop of rye-grass for seed, is to bind it loosely in small sheaves, widening them at the bottom to make them stand erect; as is done with the oats in moist weather. In that state they may stand till sufficiently dry for thrashing. By this method they dry more quickly, and are less hurt by rain, than by close binding and putting the sheaves in shocks like corn. The worst way of all is to spread the rye-grass on the moist ground, for it makes the seed malten. The sheaves, when sufficiently dry, are carried in close carts to where they are

How to
manage it
for seed.

Culture of are to be thrashed on a board, as mentioned above for
Grafs. clover. Put the straw in a rick when a hundred stone weight or so is thrashed. Carry the thrashing board to the place where another rick is intended; and so on till the whole seed be thrashed, and the straw ricked. There is necessity for close carts to save the seed, which is apt to drop out in a hot sun; and, as observed above, a hot sun ought always to be chosen for thrashing. Carry the seed in sacks to the granary or barn, there to be separated from the husks by a fanner. Spread the seed thin upon a timber floor, and turn it once or twice a-day till perfectly dry. If suffered to take a heat, it is useless for seed.

Rib-grafs. Rib-grafs (*plantago lanceolata*). Upon rich sands and loams this plant gives a considerable herbage; and on poorer and drier soils it does well for sheep, but it is inferior to some others. Mr Marshall observes, that it has stood the test of twenty years established practice in Yorkshire, and is in good estimation; though not well affected by horses, and bad for hay, from retaining its sap. The eminent Haller informs us, that the astonishing richness of the famous dairies of the Alps, described by Scheuhzer, is attributed entirely to the plenty of this plant and the *alchemilla vulgaris*. The seed is always plentiful.

Culture of The writers on agriculture reckon sainfoin prefer-
sainfoin. able to clover in many respects: They say, that it produces a larger crop; that it does not hurt cattle when eaten green; that it makes better hay; that it continues four times longer in the ground; and that it will grow on land that will bear no other crop.

Sainfoin has a very long tap-root, which is able to pierce very hard earth. The roots grow very large; and

and the larger they are, they penetrate to the greater depth; and hence it may be concluded, that this grass, Culture of
Grass. when it thrives well, receives a great part of its nourishment from below the *surface* of the soil: of course, a deep dry soil is best for the culture of sainfoin. When plants draw their nourishment from that part of the soil that is near the surface, it is not of much consequence whether their number be great or small. But the case is very different when the plants receive their food, not only near, but also deep below, the surface. Besides, plants that shoot their roots deep are often supplied with moisture, when those near the surface are parched with drought.

To render the plants of sainfoin vigorous, it is necessary that they be sown thin. The best method of doing this is by a drill; because, when sown in this manner, not only the weeds, but also the supernumerary plants, can easily be removed. It is several years before sainfoin comes to its full strength; and the number of plants sufficient to stock a field, while in this imperfect state, will make but a poor crop for the first year or two. It is therefore necessary that it be sown in such a manner as to make it easy to take up plants in such numbers, and in such order, as always to leave in the field the proper number in their proper places. This can only be done, with propriety, by sowing the plants in rows by a drill. Supposing a field to be drilled in rows at ten inches distance, the partitions may be hand-hoed, and the rows dressed in such a manner as to leave a proper number of plants. In this situation the field may remain two years; then one-fourth of the rows may be taken out in pairs, in such a manner as to make the beds of fifty inches, with six

ROWS

**Culture of
Grass.** rows in each, and intervals of thirty inches, which may be ploughed. Next year, another fourth of the rows may be taken out in the same manner, so as to leave double rows with partitions of ten inches, and intervals of thirty: All of which may be hoed at once or alternately, as it may be found most convenient.

The great quantity of this grass which the writers on this subject assure us may be raised upon an acre, and the excellency and great value of the hay made of it, should induce farmers to make a complete trial of it, and even to use the spade in place of the hoe, or hoe-plough, if necessary.

**Mode of
transplant-
ing.**

The plants taken up from a field of sainfoin may be set in another field; and if the transplanting of this grass succeeds as well as the transplanting of lucerne has done with M. Lunin de Chateaufvieux, the trouble and expence will be sufficiently recompensed by the largeness of the crops. In transplanting, it is necessary to cut off great part of the long tap-root: this will prevent it from striking very deep into the soil, and make it push out large roots in a sloping direction from the cut end of the tap-root. Sainfoin managed in this manner, will thrive even on shallow land that has a wet bottom, provided it be not overstocked with plants.

Whoever inclines to try the culture of this grass in Scotland, should take great pains in preparing the land, and making it as free from weeds as possible.

In England, as the roots strike deep in that chalky soil, this plant is not liable to be so much injured by drought as other grasses are, whose fibres strike horizontally, and lie near the surface. The quantity of hay produced is greater and better in quality than any other.

But,

But there is one advantage attending this grafs, which renders it fuperior to any other; and that arifes from feeding with it milch cows. The prodigious increafe of milk which it makes is aftonifhing, being nearly double that produced by any other green food. The milk is alfo better, and yields more cream than any other; and the butter procured from it is much better coloured and flavoured.

Culture of
Graf.

The following remarks by an Englifh farmer are made from much experience and obfervation.

Sainfoin is much cultivated in thofe parts where the foil is of a chalky kind. It will always fucceed well where the roots run deep; the worft foil of all for it is where there is a bed of cold wet clay, which the tender fibres cannot penetrate. This plant will make a greater increafe of produce, by at leaft 30 times, than common grafs or turf on poor land. Where it meets with chalk or ftone, it will extend its roots through the cracks and chinks to a very great depth in fearch of nourifhment. The drynefs is of more confequence than the richnefs of land for fainfoin; although land that is both dry and rich will always produce the largeft crops.

Remarks
on the cul-
ture of fain-
foin in
England.

It is very commonly fown broad-caft; but it is found to anfwer beft in drills, efpecially if the land be made fine by repeated ploughing, rolling, and harrowing. Much depends on the depth at which this feed is fown. If it be buried more than an inch deep, it will feldom grow; and if left uncovered, it will push out its roots above ground, and thefe will be killed by the air. March and the beginning of April are the beft feafons for fowing it, as the feverity of winter and the drought of fummer are equally unfavourable to the young plants.

**Culture of
Grass.** A bushel of seed sown broad-cast, or half that quantity in drills, if good, is sufficient for an acre. The drills should be 30 inches apart, to admit of horse-hoeing between them. Much, however, depends on the goodness of the seed, which may be best judged of by the following marks :

The husk ought to be of a bright colour, the kernel plump, of a gray or bluish colour without, and if cut across, greenish and fresh within; if it be thin and furrowed, and of a yellowish cast, it will seldom grow. When the plants stand single, and have room to spread, they produce the greatest quantity of herbage, and the seed ripens best. But farmers in general, from a mistaken notion of all that appears to be waste ground being unprofitable, plant them so close, that they choke and impoverish each other, and often die in a few years. Single plants run deepest and draw most nourishment; they are also easiest kept free from weeds. A single plant will often produce half a pound of hay, when dry. On rich land this plant will yield two good crops in a year, with a moderate share of culture. A good crop must not be expected the first year: but if the plants stand not too thick, they will increase in size the second year prodigiously.

No cattle should be turned on the field the first winter after the corn is off with which it was sown, as their feet will injure the young plants. Sheep should not come on the following summer, because they would bite off the crown of the plants, and prevent their shooting again. A small quantity of soapers ashes as a top-dressing will be of great service, if laid on the first winter.

If the sainfoin be cut just before it comes into bloom,

it

it is admirable food for horned cattle; and if cut thus <sup>Culture of
Grass.</sup> early, it will yield a second crop the same season. But if it proves a wet season, it is better to let it stand till its bloom be perfected; for great care must be taken, in making it into hay, that the flowers do not drop off, as cows are very fond of them; and it requires more time than any other hay in drying. Sainfoin is so excellent a fodder for horses, that they require no oats while they eat it, although they be worked hard all the time. Sheep will also be fattened with it faster than with any other food.

If the whole season for cutting proves very rainy, it is better to let the crop stand for seed, as that will amply repay the loss of the hay; because it will not only fetch a good price, but a peck of it will go as far as a peck and a half of oats for horses.

The best time of cutting the seeded sainfoin is, when the greatest part of the seed is well filled, the first blown ripe, and the last blown beginning to open. For want of this care some people have lost most of their seed by letting it stand too ripe. Seeded sainfoin should always be cut in the morning or evening, when the dews render the stalks tender. If cut when the sun shines hot, much of the seed will fall out and be lost.

An acre of very ordinary land, when improved by this grass, will maintain four cows very well from the first of April to the end of November; and afford, besides, a sufficient store of hay to make the greater part of their food the four months following. <sup>Number of
cattle it
will main-
tain.</sup>

If the soil be tolerably good, a field of sainfoin will last from 15 to 20 years in prime; but at the end of seven or eight years, it will be necessary to lay on a moderate

Culture of moderate coat of well-rotted dung ; or, if the soil be
Grais. very light and sandy, of marl. By this means the
 future crops, and the duration of the plants in health
 and vigour, will be greatly increased and prolonged.
 Hence it will appear, that for poor land there is no-
 thing equal to this grafs in point of advantage to the
 farmer.

Clover will last only two years in perfection ; and of-
 ten, if the soil be cold and moist, near half the plants
 will rot, and bald patches be found in every part of the
 field the second year. Besides, from our frequent rains
 during the month of September, many crops left for
 feeding are lost. But from the quantity and excellent
 quality of this grafs (sainfoin), and its ripening earlier,
 and continuing in vigour so much longer, much risk
 and certain expence are avoided, and a large annual pro-
 fit accrues to the farmer.

Culture of
Lucerne.

The writers on agriculture, ancient as well as mo-
 dern, bestow the highest encomiums upon lucerne as
 affording excellent hay, and producing very large crops.
 Lucerne remains at least 10 or 12 years in the ground,
 and produces about eight tons of hay upon the Scots
 acre. There is but little of it cultivated in Scotland.
 However, it has been tried in several parts of that
 country ; and it is found, that, when the seed is good,
 it comes up very well, and stands the winter frost. But
 the chief objection to this grafs in Scotland, has been
 the difficulty of keeping the soil open and free from
 weeds. This cannot be done effectually by any other
 means than horse-hoeing ; and accordingly this method
 was first proposed by Mr Tull, and afterwards practised
 successfully by M. de Chateauxvieux near Geneva. It

may

may be of use therefore to give a view of that gentleman's method of cultivating lucerne. Culture of
Grass.

He does not mention any thing particular as to the manner of preparing the land ; but only observes, in general, that no pains should be spared in preparing it. He tried the sowing of lucerne both in rows upon the beds ; ~~there~~ it was intended to stand ; likewise the sowing it in a nursery, and afterwards transplanting it into the beds prepared for it. He prefers transplanting ; because, when transplanted, part of the tap-root is cut off, and the plant shoots out a number of lateral branches from the cut part of the root, which makes it spread its roots nearer the surface, and consequently renders it more easily cultivated : besides, this circumstance adapts it to a shallow soil, in which, if left in its natural state, it would not grow.

The transplanting of lucerne is attended with many ^{Transplant-}advantages. The land may be prepared in the summer ^{ing.} for receiving the plants from the nursery in autumn ; by which means the field must be in a much better situation than if the seed had been sown upon it in the spring. By transplanting, the rows can be made more regular, and the intended distances more exactly observed ; and consequently the hoeing can be performed more perfectly, and with less expence. M. Chateauvieux likewise tried the lucerne in single beds three feet wide, with single rows ; in beds three feet nine inches wide, with double rows ; and in beds four feet three inches wide, with triple rows. The plants in the single rows were six inches asunder, and those in the double and triple rows were about eight or nine inches. In a course of three years he found, that a single row produced more than a triple row of the same

Culture of length. The plants of lucerne, when cultivated by trans-
Grass. plantation, should be at least six inches asunder, to allow them room for extending their crowns.

He further observes, that the beds or ridges ought to be raised in the middle; that a small trench, two or three inches deep, should be drawn in the middle; and that the plants ought to be set in this trench, covered with earth up to the neck. He says, that if the lucerne be sown in spring, and in a warm soil, it will be ready for transplanting in September; that, if the weather be too hot and dry, the transplanting should be delayed till October; and that, if the weather be unfavourable during both these months, this operation must be delayed till spring. He further directs, that the plants should be carefully taken out of the nursery, so as not to damage the roots; that the roots be left only about six or seven inches long; that the green crops be cut off within about two inches of the crown; that they be put into water as soon as taken up, there to remain till they are planted; and that they should be planted with a planting stick, in the same manner as cabbages.

He does not give particular directions as to the times of horse-hoeing; but only says, in general, that the intervals should be stirred once in the month during the whole time that the lucerne is in a growing state. He likewise observes, that great care ought to be taken not to suffer any weeds to grow among the plants, at least for the first two or three years; and for this purpose, that the rows, as well as the edges of the intervals where the plough cannot go, should be weeded by the hand.

Mr Young observes that the culture of this plant is
 one

one of the principal features of French husbandry. Culture of
Grass.
 "We have gone, says he *, to the French school for the culture of it; yet it is ill managed, and with bad success, in England, and has been so in every period: but in France, even in climates similar to our own, it is Mr Young
on the
French cul-
ture.
 an object of almost uniform profit: and it must therefore be ~~unfortunate~~ indeed, if we do not extract something from the French practice deserving our attention and imitation. The first leading circumstance that demands our attention, is the unvarying practice of sowing it broadcast. The lucerne in Spain, which is of a luxuriance we have no conception of, and the little I have seen in Italy, is all sown in the same way. A contrary practice, namely, that of drilling, has taken place in England. It has been repeatedly urged, that the humidity of our climate renders hoeing necessary, to keep it free from the spontaneous grasses; and if hoeing is necessary, drilling is certainly so. But this necessity is not found to take place in the north of France, the climate of which very nearly resembles our own. After some years these grasses destroy it there as well as here; but the French think it much more profitable when that happens to plough it up, than to ensure a longer possession by perpetual expence and attention.

"A Frenchman from Provence (Rocque) introduced this broadcast culture of lucerne, about 25 years ago, into England. I saw his crops, which were very fine, and equal to any in the north of France. Mr Arbuthnot of Mitcham had it also on the same method on a

G 2

large

* *Travels*, vol. i.

Culture of
Grass.

large scale, and with considerable success: other persons have succeeded equally well, whose experiments may be found in the registers of my agricultural tours through England; the method, however, has not been generally pursued, and the little lucerne to be found in England is chiefly in drills. It certainly deserves enquiry, whether this is not the reason of the cultivation at large not having made a greater progress with us. The introduction of hoes and horse-hoes among crops that are cleared but once a-year from the land, and with no necessity of mowing them close to the ground, appears to be much easier, and more practicable, than hoeing and horse-hoeing a meadow cut and cleared thrice in a year, and which must of necessity be mown quite closely. The broadcast succeeds well in every part of France in proportion to the goodness of the soil and the management, like every other crop."

Previous
crop.

This author suggests, that a turnip or cabbage crop is the right preparation. If the field be foul the crop ought to be repeated, and during both years it ought to be fed on the land: The lucerne ought then to be sown at the rate of two bushels per English acre, along with barley or oats. Should weeds appear the first year, an expence of 10s. per acre ought to be laid out in drawing or otherwise extirpating them, and after that the lucerne should take its chance. No manure should be allowed till the crop is two years old. Its ameliorating effect upon the soil is very great.

Burnet.

Burnet (*poterium sanguisorba*) is peculiarly adapted to poor land; besides, it proves an excellent winter pasture when hardly any thing else vegetates. Other advantages are, It makes good butter; it never blows or swells cattle; it is fine pasture for sheep; and will flourish

rich well on poor, light, sandy, or stony soils, or even on dry chalk hills. Culture of
Grass.

The cultivation of it is neither hazardous nor expensive. If the land is prepared as is generally done for turnips, there is no danger of its failing. After the first year, it will be attended with very little expence, as the flat circular spread of its leaves will keep down, or prevent the growth of weeds. Culture of
burnet.

On the failure of turnips, either from the fly or the black worm, some of our farmers have sown the land with burnet, and in March following had a fine pasture for their sheep and lambs. It will perfect its seed twice in a summer; and this seed is said to be as good as oats for horses; but it is too valuable to be applied to that use.

It is sometimes sown late in the spring with oats and barley, and succeeds very well; but it is best to sow it singly in the beginning of July, when there is a prospect of rain, on a small piece of land, and in October following transplant it in rows two feet apart, and about a foot distant in the rows. This is a proper distance, and gives opportunity for hoeing the intervals in the succeeding spring and summer.

After it is fed down with cattle, it should be harrowed clean. Some horses will not eat it freely at first, but in two or three days they are generally very fond of it. It affords rich pleasant milk, and in great plenty.

A gentleman farmer near Maidstone, some years since, sowed four acres as soon as the crop of oats was got off, which was the latter end of August. He threw in 12 pounds of seed per acre, broad-cast; and no rain falling until the middle of September, the plants did not appear before the latter end of that month.

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Grass.

There was however a good crop ; and in the spring he set the plants out with a turnip hoe, leaving them about a foot distant from each other. But the drill method is preferable, as it saves more than half the seed. The land was a poor dry gravel, not worth three shillings an acre for any thing else.

The severest frost never injures this plant ; and oftener it is fed the thicker are its leaves, which spring constantly from its root.

Resists frost
and clove
feeding.

There are large tracts of the finest parts, of what are called the *South Downs* in England, upon which this plant forms half the indigenous pasturage. It abounds also much in that country on all other chalk downs, though it will flourish as already mentioned on poor land, as sand, clay, peat, &c.

We shall here enumerate a few more of the grasses which have been accounted valuable, or are likely to become so, requesting the reader at the same time to look back to what we have already stated upon the subject, when discussing the kinds of vegetables proper to be raised for feeding cattle.

Bulbous
foxtail-
grass.

Alopecurus bulbosus, (bulbous foxtail-grass), is recommended by Dr Anderson, as promising on some occasions to afford a valuable pasture-grass. It seems chiefly, he observes, to delight in a moist soil, and therefore promises to be only fit for a meadow pasture-grass. The quality that first recommended it to his notice, was the unusual firmness that its matted roots gave to the surface of the ground, naturally soft and moist, in which it grew ; which seemed to promise that it might be of use

use upon such soils, chiefly in preventing them from being much poached by the feet of cattle which might pasture upon them. Mossy soils especially are so much hurt by poaching, that any thing that promises to be of use in preventing it deserves to be attended to.

Poa pratensis, (great meadow-grass), seems to approach *Poa trivialis* in many respects to the nature of the purple fescue; only that its leaves are broader, and not near so long, being only about a foot or 16 inches at their greatest length. Like it, it produces few seed-stalks and many leaves, and is an abiding plant. It affects chiefly the dry parts of meadows, though it is to be found on most good pastures. It is very retentive of its seeds, and may therefore be suffered to remain till the stalks are quite dry. It blossoms the beginning of June, and its seeds are ripe in July.

Poa compressa, (creeping meadow-grass), according to Dr Anderson, seems to be the most valuable grass of any of this genus. Its leaves are firm and succulent, of a dark Saxon-green colour; and grow so close upon one another, as to form the richest pile of pasture-grass. The flower-stalks, if suffered to grow, appear in sufficient quantities; but the growth of these does not prevent the growth of the leaves, both advancing together during the whole summer; and when the stalks fade, the leaves continue as green as before. Its leaves are much larger and more abundant than the common meadow-grass, (*poa trivialis*); and therefore it better deserves to be cultivated.

Anthoxanthum odoratum, (vernal grass), grows very commonly on dry hills, and likewise on sound rich meadow-land. It is one of the earliest grasses we have; and from its being found on such kinds of pastures as

Culture of
Grass. sheep are fond of, and from whence excellent mutton comes, it is most likely to be a good grass for sheep pastures. It gives a grateful odour to hay. In one respect, it is very easy to gather, as it sheds its seeds upon the least rubbing. A correspondent of the English Society, however, mentions a difficulty, that occurs in collecting them, owing to its being surrounded with other grasses at the time of its ripening, and being almost hid among them. If it be not carefully watched when nearly ripe, he observes, and gathered within a few days after it comes to maturity, great part of the seed will be lost. The twisted elastic awns, which adhere to the seed, lift them out of their receptacles with the least motion from the wind, even while the straw and ear remain quite erect. It is found mostly in the moist parts of meadows; very little of it on dry pastures. It flowers about the beginning of May, and is ripe about the middle of June.

Crested
dog's-tail
grass.

Cynosurus cristatus, (crested dog's-tail grass). Mr Stillingfleet imagines this grass to be proper for parks, from his having known one, where it abounds, that is famous for excellent venison. He recommends it also, from experience, as good for sheep; the best mutton he ever tasted, next to that which comes from hills where the purple and sheep's fescue, the fine bent, and the silver hair-grasses abound, having been from sheep fed with it. He adds, that it makes a very fine turf upon dry sandy or chalky soils: but unless swept over with the scythe, its flowering stems will look brown; which is the case of all grasses which are not fed on by variety of animals. For that some animals will eat the flowering stems is evident from commons, where scarcely any parts of grasses appear but the radical leaves. This
grass

grafs is said to be the easiest of the whole group to collect a quantity of seed from. It flowers in June, and is ripe in July. Culture of
Graft.

The Rev. Mr Arthur Young observes, that “ to find the appearance of the bents of this grafs in land but moist pastures, a man would think it unpromising plant; but the rich marshes of Bridgewater and Boscawen, the famous pasturages of Paniton in Devonshire, and those close to Mr Buller’s castle near Leskeard in Cornwall, Mr Thorne’s bullock-grounds on Dunstone bottom, near Tavistock, Mrs Williams’s at Little Malvern in Worcestershire (which are among the richest pastures in the kingdom), all abound very greatly in this grafs: in some of them it is the predominant herbage. Mr Marshall places it as the most prevailing plant in the best grafs meadows of the vale of Pickering, some of which will feed a large cow from Mayday to Michaelmas. Very fortunately it abounds much with seed, so that I have had many bushels gathered in a season by poor women and children at 1s. a pound, and laid down many acres with it successfully. Attention should be paid to its being ripe; for I once ordered eight bushels to be sown on eight acres, and it failed from a deficiency in ripeness.”

Stipa pennata, (cock’s-tail, or feather grafs.)

Cock’s-tail
or feather
grafs.
Fine bent.

Agrostis capillaris (fine bent), is recommended by Mr Stillingfleet, from his having always found it in great plenty on the best sheep pastures, in the different counties of England that are remarkable for good mutton. This grafs flowers and ripens its seed the latest of them all. It seems to be lost the former part of the year, but vegetates luxuriantly towards the autumn. It appears to be fond of moist ground. It retains its seed till

Culture of till full ripe; flowers the latter end of July, and is ripe
the latter end of August.

Mountain *Aira flexuosa*, (mountain hair.)

hair. — *caryophylla*, (silver hair.)

Silver hair.

The same may be said of these two grasses as of the preceding one.

Flote fesc.
cuc.

Festuca fluitans, (flote fescue.) In a published in the *Amoenitates Academicæ*, vol. iii. entitled *Plantæ Esculentæ*, we are informed, that "the seeds of this grass are gathered yearly in Poland, and from thence carried into Germany, and sometimes into Sweden, and sold under the name of *manna seeds*.—These are much used at the tables of the great, on account of their nourishing quality and agreeable taste. It is wonderful (adds the author), that amongst us these seeds have hitherto been neglected, since they are so easily collected and cleansed." There is a clamminess on the ear of the flote fescue, when the seeds are ripe, that tastes like honey; and for this reason perhaps they are called *manna seeds*.

Linnaeus (*Flor. Suec.* art. 95.) says that the bran of this grass will cure horses troubled with botts, if kept from drinking for some hours.

Concerning this grass we have the following information by Mr Stillingfleet. "Mr Dean, a very sensible farmer at Ruscomb, Berkshire, assured me that a field, always lying under water, of about four acres, that was occupied by his father when he was a boy, was covered with a kind of grass, that maintained five farm horses in good heart from April to the end of harvest, without giving them any other kind of food, and that it yielded more than they could eat. He, at my desire, brought me some of the grass, which proved

ned to be the flote fescue with a mixture of the marsh-
 bent; whether this last contributes much towards fur- Culture of
Grais.
 nishing so good pasture for horses, I cannot say. They
 both throw out roots at the joints of the stalks, and
 therefore are likely to grow to a great length. In the
 index of dubious plants at the end of Ray's Synopsis,
 there is mention made of a grafs, under the name of
gramen caninum sup-^{er} longissimum, growing not far
 from Salisbury, 24 feet long. This must by its length
 be a grafs with a creeping stalk; and that there is a
 grafs in Wiltshire growing in watery meadows, so
 valuable that an acre of it lets from 10l. to 12l. I
 have been informed by several persons. These circum-
 stances incline me to think it must be the flote fescue;
 but whatever grafs it be, it certainly must deserve to
 be inquired after."

Alopecurus pratensis, (meadow foxtail.) Linnæus says Meadow
foxtail.
 that this is a proper grafs to sow on grounds that have
 been drained. Mr Stillingfleet was informed, that the
 best hay which comes to London is from the meadows
 where this grafs abounds. It is scarce in many parts
 of England, particularly Herefordshire, Berkshire, and
 Norfolk. It might be gathered at almost any time of
 the year from the hay-rick, as it does not shed its seeds
 without rubbing, which is the case of but few grasses.
 It is among the most grateful of all grasses to cattle. It
 is ripe about the latter end of June.

The Rev. Mr Young remarks, that "for moist
 loams and clays, there cannot be a better grafs; it is
 very early, it abides on this farm often nine or ten years
 on the soils upon which the meadow fescue gives way
 to others; it has also been found by Mr Majendie har-
 dier against frosts than the *poa trivialis*; the greatest ob-
 jection

Culture of jection to it is the difficulty of getting the seed in any
Grafs. degree of plenty; there is an insect that feeds on it, and occasions much disappointment. Mr Professor Martyn, in his excellent *Flora Rustica*, speaks highly of this grafs, and says, the seeds may be collected without much difficulty; but he does not there advert to the insect which is so pernicious, noticed by Mr Majendie, and by the ingenious Mr Swayne in his *Præmina Pæscua*. In a field on this farm, where it is very well established, and the herbage thick, it produces very few seed-stalks."

Trivialis *Poa trivialis*.—Mr Boys of "Betshanger in Kent, has been the largest cultivator of this grafs in the kingdom, and sold large quantities of the seed; but gave it up for want of a demand. It is an excellent grafs on good and found and moist loams. It is accounted in Lombardy, "the queen of meadow plants (*la regina dell'erbe*,) for dry pastures or water meadows; multiplying itself much by seed, and little by the root; so that if attention be not paid to permit some seed to fall, its quantity will sensibly diminish. Excellent for all sorts of cattle."

"This hint concerning the seed is worth attention in England. Major Cartwright has found the *poa pratensis* to be an excellent grafs on rich loams; and both succeeded well with Sir William Clayton of Harleyford."

"Trefoil (*medicago lupulina*), though only a biennial, is sure to shed so much seed, that it rarely wears out of land. It is a good plant, not at all nice in soil, and seed cheap."

Cow-grafs. "Cow-grafs (*trifolium medium*), is an excellent plant for clays and strong loams. It is said, in the Lincoln Report, that Mr Ancel got good crops on a rabbit sand; the hint is worth pursuing. It is much more
 abiding

abiding than common clover. The feed is always to be had; it is known also under the name of marle grafs." Culture of
Grafs.

Poa annua, (annual meadow-grafs). "This grafs (says Mr. Stillingfleet) makes the finest of turfs. It grows everywhere by way sides, and on rich found

It is called in some parts the *Suffolk-grafs*.

I have seen whole fields of it in High Suffolk without any mixture of other grafs; and as some of the best salt butter we have in London comes from that country, it is most likely to be the best grafs for the dairy. I have seen a whole park in Suffolk covered with this grafs; but whether it affords good venison, I cannot tell, having never tasted of any from it. I should rather think not, and that the best pasture for sheep is also the best for deer. However, this wants trial. I remarked on Malvern-hill something particular in relation to this grafs. A walk that was made there for the convenience of the water-drinkers, in less than a year was covered in many places with it, though I could not find one single plant of it besides in any part of the hill. This was no doubt owing to the frequent treading, which above all things makes this grafs flourish; and therefore it is evident that rolling must be very serviceable to it. It has been objected, that this grafs is not free from *bents*, by which word is meant the flowering-stems. I answer, that this is most certainly true, and that there is no grafs without them. But the flowers and stems do not grow so soon brown as those of other grafs; and being much shorter, they do not cover the radical leaves so much; and therefore this grafs affords a more agreeable turf without mowing than any other whatever that I know of." The seeds of this species

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Grass.

cies drop off before they are dry, and, to appearance, before they are ripe. The utmost care is therefore necessary in gathering the blades, without which very few of the seeds will be saved. It ripens from the middle of April, to so late, it is believed, as the end of October; but mostly disappears in the middle of the summer. It grows in any soil and situation, but ~~rather~~ affects the shade.

Agrostis
cornucopiae.

A new grass from America (named *agrostis cornucopiae*), was some time ago much advertised and extolled, as possessing the most wonderful qualities, and the seeds of it were sold at the enormous rate of 68l. the bushel. But we have not heard that it has at all answered expectation. On the contrary, we are informed by Dr Anderson, in one of his publications *, that "it has upon trial been found to be good for nothing. Of the seeds sown, few of them ever germinated: but enough of plants made their appearance, to ascertain, that the grass, in respect of quality, is amongst the poorest of the tribe; and that it is an *annual* plant, and altogether unprofitable to the farmer."

Chicory.

Chicorium intybus, (chicory).

Mr Arthur Young has anxiously endeavoured to diffuse a knowledge of this plant; and he appears to have been the first person that introduced it into the agriculture of England from France, where it grows naturally on the sides of the roads and paths, and is sometimes cultivated as a fallad. When it has been sown by itself, in ground prepared by good tillage, it has yielded two crops the same year. When sown amongst oats, no
crop

* See, vol. i. p. 38.

erop is expected till the following year. This plant de- Culture of
Grass.
fies the greatest droughts, and resists every storm. Being
of very early growth, its first leaves, which are large
and tufted, spread sidewise, and cover the ground so as
to retain the moisture, and preserve its roots from the
heat, which so often dries up every other vegetable pro-
duct, or : it has not any thing to fear from storms, for
its thick and stiff stalks support themselves against the
winds and heaviest rains. The most severe cold and
frosts cannot injure it. The quickness of its growth,
above all, renders it most valuable, because it furnishes
an abundance of salutary fodder in a season when the
cattle, disgusted with their dry winter food, greedily
devour fresh plants.

This plant is greedily eaten by all sorts of cattle, but
it is difficult to make into hay. It is very voluminous,
and dries ill, unless the weather be very favourable for
it. The dry fodder, however, which it does yield, is
eaten with pleasure by the cattle. The following is the
result of an experiment made with it by Mr Young * up-
on an acre of ground

sown April 1788.

		Green produce.
		Tons cwt.
Cut July 24,	-	9 10
October 17,	-	9 14
Produce of the year of sowing,		<u>19 4</u>
		1789.

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Grafts.

Green Produce.

			Tons.	Cwt.
1789. Cut May 21,	-		12	11
July 24,	-		16	4
December 3,	-		9	19
Produce of the second year,			38	9
1790. Cut June 8,	-		18	15
August 15,	-		19	9
Produce of the third year,			38	4

The following English graffes are recommended to attention by Mr Curtis, author of the *Flora Londinensis*; and he has given directions for making experiments with grafts seeds in small quantities.

Tall oat-grafs.

" *Avena elatior*, (tall oat-grafs); common in wet meadows, and by the sides of hedges, early, and very productive, but coarse. Its seed might be had in any quantity from France.

Yellow oat-grafs.

" *Avena flavescens*, (yellow oat-grafs); affects a dry soil, is early and productive, bids fair to make a good sheep pasture.

Rough oat-grafs.

" *Avena pubescens*, (rough oat-grafs); soil and situation nearly similar to that of the meadow fescue; hardy, early, and productive.

Upright broom-grafs.

" *Bromus erectus*, (upright broom-grafs); peculiar to chalky soils; early and productive; promises to be a good grafts for chalky lands, and thrives indeed very well on others.

Blue dog's-tail.

" *Cynofurus ceruleus*, (blue dogs-tail grafts;); earliest of all the graffes; grows naturally on the tops of the highest

est limestone rocks in the northern part of Great Britain: not very productive, yet may perhaps answer in certain situations, especially as a grafs for sheep: bears the drought of summer remarkably well: at all events seems more likely to answer than the sheep's fescue-grafs, on which such encomiums have, most unjustly, been lavished. Culture of
Grafts.

“ *Dactylis glomeratus*, (rough cock's-foot grafs); a Rough rough coarse grafs, but extremely hard and productive: cock's-foot
soil and situation the same as the meadow-fescue. grafs.

“ *Festuca elatior*, (tall fescue grafs); tall and coarse, Tall fescue
but very productive; affects wet situations. grafs.

“ *Festuca duriuscula*, (hard fescue grafs); affects such Hard fescue
situations as the smooth-stalked meadow grafs; is early grafs.
and tolerably productive: its foliage is fine, and of a beautiful green; hence we have sometimes thought it was of all others the fittest for a grafs-plat or bowling-green; but we have found, that though it thrives very much when first sown or planted, it is apt to become thin, and die away after a while.

“ *Phleum pratense*, (meadow cats-tail grafs); affects Meadow
wet situations; is very productive, but coarse and late.” cat's-tail
grafs.

To sow grafs seeds in small quantities, this author gives the following directions:—

“ If a piece of ground can be had, that is neither very moist nor very dry, it will answer for several sorts of seeds: they may then be sown on one spot; but if such a piece cannot be obtained, they must be sown on separate spots according to their respective qualities, no matter whether in a garden, a nursery, or a field, provided it be well secured and clean. Dig up the ground, level and rake it, then sow each kind of seed thinly in a separate row, each row about foot apart, Rules for
making ex-
periments
with grafs-
seeds.

Culture of
Grass. and cover them over lightly with the earth; the latter end of August or beginning of September will be the most proper time for this business. If the weather be not uncommonly dry the seeds will quickly vegetate, and the only attention they will require will be to be carefully weeded. In about a fortnight from their coming up, such of the plants as grow thickly together may be thinned, and those which are taken up transplanted so as to make more rows of the same grass.

“ If the winter should be very severe, though natives, as seedlings, they may receive injury; therefore it will not be amiss to protect them with mats, fern, or by some other contrivance.

“ Advantage should be taken of the first dry weather in the spring, to roll or tread them down, in order to fasten their roots in the earth, which the frost generally loosens: care must still be taken to keep them perfectly clear from weeds. As the spring advances, many of them will throw up their flowering stems, and some of them will continue to do so all the summer. As the seed in each spike or panicle ripens, it must be very carefully gathered and sown in the autumn, at which time the roots of the original plants, which will now bear separating, should be divided, and transplanted, so as to form more rows; the roots of the smooth-stalked meadow-grass, in particular, creeping like couch-grass, may readily be increased in this way; and thus by degrees a large plantation of these grasses may be formed, and much seed collected.

“ While the seeds are thus increasing, the piece or pieces of ground, which are intended to be laid down, should be got in order. If very foul, perhaps the best practice

practice (if pasture land) will be to pare off the sward and burn it on the ground: or if this should not be thought advisable, it will be proper to plough up the ground and harrow it repeatedly, burning the roots of couch-grafs and other noxious plants, till the ground is become tolerably clean; to render it perfectly so, some cleansing crop, as potatoes or turnips, should be planted or sown.

Culture of
Grass.

“ By this means, the ground we propose laying down will be got into excellent order without much loss; and being now ready to form into a meadow or pasture, should be sown broad-cast with the following compositions:

- Meadow fox-tail*, one pint;
 - Meadow fescue*, ditto;
 - Smooth-stalked meadow*, half a pint;
 - Rough stalked meadow*, ditto;
 - Crested dog's-tail*, a quarter of a pint;
 - Sweet-scented vernal*, ditto;
 - Dutch clover* (*trifolium repens*), half a pint;
 - Wild red clover* (*trifolium pratense*), or, in its stead,
 - Broad clover of the shops*, ditto;
- For wet land, the *crested dog's-tail* and *smooth-stalked meadow* may be omitted, especially the former.

“ Such a composition as this, sown in the proportion of about three bushels to an acre on a suitable soil, in a favourable situation, will, I am bold to assert, form in two years a most excellent meadow; and, as all the plants sown are strong hardy perennials, they will not easily suffer their places to be usurped by any noxious plants, which by manure or other means, in spite of all our endeavours, will be apt to insinuate themselves; if

Culture of
Grafts. they should, they must be carefully extirpated ; for such a meadow is deserving of the greatest attention : but if that attention cannot be bestowed on it, and in process of time weeds should predominate over the crop originally sown, the whole should be ploughed up, and fresh sown with the same seeds, or with a better composition, if such shall be discovered ; for I have no doubt but at some future time, it will be as common to sow a meadow with a composition somewhat like this, as it now is to sow a field with wheat or barley.

As it is of much importance for the practical agriculturist to have under his eye, at one view, the kinds of grasses best suited to particular soils, together with the quantities proper to be sown upon a certain extent of land, we shall here state, in his own words, the valuable remarks of the Rev. Mr A. Young upon these points.

“ The grass plants, says this author, may be thus arranged :

<i>Clay</i>	<i>Loam</i>	<i>Sand</i>	<i>Chalk</i>	<i>Peat</i>
Cow-grass.	Whiteclover.	Whiteclover.	Yarrow.	Whiteclover
Cocks-foot	Rye.	Rye.	Burnet.	Dogs-tail.
Dogs-tail.	York-white.	York white.	Trefoil.	Cocks-foot.
Fescue.	Fescue.	Yarrow.	Whiteclover	Rib.
Fox-tail.	Fox-tail.	Burnet.	Sainfoin.	York white.
Oat-grass.	Dogs-tail.	Trefoil.		Rye.
Trefoil.	Poa.	Rib.		Fox-tail.
York white.	Timothy.			Fescue.
Timothy.	Yarrow.			Timothy.
	Lucern.			

However, with some latitude :—It may generally be received as a safe maxim, that the more seeds are sown the

the better, provided inferior plants be not assigned to land that will produce better : thus, in the column of *loam, Yorkshire white* should not be sown, provided the four following grasses in the column can be had in quantity ; which may not be the case. Culture of
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“ There are many other plants, some of which have been tried under my direction, which deserve much attention ; but I have not named them in the above mentioned list, because the seed cannot be procured but with difficulty ; some perennial vetches, clovers, melilots, lotuses, &c. Several others are highly spoken of by some writers ; yet, as my own trials have not been equally successful, I am not authorized to recommend them. I never tried the *vicia sepium* sufficiently to give an opinion of it ; but by Mr Swayne’s account it deserves much attention. I do not think the Board of Agriculture could more essentially serve the public than by establishing a farm, and cultivating these and other plants, for supplying seed to their members, who wished to cultivate them ; a very little land would be sufficient.

“ In regard to the quantities per acre of these plants, this must necessarily depend on the means of getting them. In situations where women and children are fully employed, it may be difficult to procure large quantities gathered by hand ; in such places a man must be content with what can be bought. *Crested dog’s-tail* is so very generally to be thus procured, that I cannot but suppose it, in a good measure, at command. However, without adverting to this point, I may remark, that from the lands which I have laid down to grass to a considerable extent, and in which I have used every one of those plants largely, except the poa, and

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Grafts. that on a smaller scale I am inclined to think, that the following quantities may by safely recommended.

CLAY.

*Seeds.**Substitutes.*

Cow-grafs, 5 lbs.

Trefoil, 5 lbs.

Dog's-tail, 10 lbs.

Fescue, 1 bushel;

Fox-tail, 1 ditto;

Yorkshire white 2 bushels;

Timothy, 4 lbs.

Ditto, 4 lbs. Yorkshire
white, 1 bushel.

LOAM.

White clover, 5 lbs.

Dog's-tail, 10 lbs.

Rye, 1 peck;

Fescue, 3 ditto;

Fox-tail, 3 ditto;

Yarrow, 2 ditto;

Rye, 1 peck;

Rib-grafs, 4 lbs.

Yorkshire white;

Timothy, 4 lbs.

Cow-grafs, 5 lbs.

SAND.

White clover, 7 lbs.

Trefoil, 5 lbs.

Burnet, 6 lbs.

Rye, 1 peck;

Yarrow, 1 bushel;

{ Rye, 1 peck;
{ Rib, 4 lbs.

CHALK.

Burnet, 10 lbs.

Trefoil, 5 lbs.

White clover, 5 lbs.

Yarrow, 1 bushel;

Rye, 1 bushel.

PEAT.

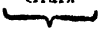
White clover, 10 lbs.

Dogs-tail, 10 lbs.

Rye, 1 peck;

York-white, 6 pecks;

fox-tail,

<i>Seeds.</i>	<i>Substitutes.</i>	<i>Culture of Grafts.</i>
Fox-tail, 2 pecks ;	Rib, 5 lbs.	
Fescue, 2 pecks ;	Cow-grafs, 4lbs.	
Timothy, 1 ditto.		

4. *Of the mode of improving Grafts Lands by flooding them artificially with water.*

One of the most important improvements in agriculture that has occurred of late years, is the practice of overflowing or flooding grafts lands, which is now coming greatly into use, not only on level grounds, but in all situations in which a command of water can be obtained. In the Monthly Review for October, 1788, the editors acknowledge the favour of a correspondent, who informed them, that watering of meadows was practised during the reign of Queen Elizabeth and James I. A book was written upon the subject by one Rowland Vaughan, who seems to have been the inventor of this art, and who practised it on a very extensive plan in the Golden Valley in Herefordshire. Till this note to the Reviewers appeared, the inhabitants of a village called South Cerney in Gloucestershire had assumed the honour of the invention to themselves, as we are informed in a treatise upon the subject by the Rev. Mr Wright curate of the place. According to a received tradition in that village, watering of meadows has been practised there for about a century, and was introduced by one *Welladvise*, a wealthy farmer in South Cerney. His first experiment was by cutting a large ditch in the middle of his ground, from which he threw the water over some parts, and allowed it to stagnate in others : but finding this not to answer his expectations, he improved his method by

Culture of
Grafts. } cutting drains and filling up the hollows; and thus he
Advanta- } succeeded so well, that his neighbours, who at first call-
ges of wa- } ed him a madman, soon changed their opinion, and be-
tering. } gan to imitate his example.

The advantages which attend the watering of meadows are many and great; not only as excellent crops of grafts are thus raised, but as they appear so early, that they are of infinite service to the farmers for food to their cattle in the spring before the natural grafts rise. By watering we have plenty of grafts in the beginning of March, and even earlier when the season is mild. The good effects of this kind of grafts upon all sorts of cattle are likewise astonishing, especially upon such as have been hardly wintered; and Mr Wright informs us, that the farmers in his neighbourhood, by means of watering their lands, are enabled to begin the making of cheese at least a month sooner than their neighbours who have not the same advantage. Grafts raised by watering is found to be admirable for the nurture of lambs; not only those designed for fattening, but such as are to be kept for store: For if lambs when very young are stopped and stunted in their growth, they not only become contracted for life themselves, but in some measure communicate the same diminutive size to their young. The best remedy for preventing this evil is the spring feed from watered meadows; and Mr Wright is of opinion, that if the young of all kinds of farmer's stock were immediately encouraged by plenty of food, and kept continually in a growing state, there would in a few years be a notable change both in the size and shape of cattle in general. Such indeed is the forwardness of grafts from watered meadows, that the feed between March and

and May is worth a guinea per acre ; and in June an acre will yield two tons of hay, and the after-math is always worth twenty shillings ; and nearly the same quantity is constantly obtained whether the summer be dry or wet. In dry summers also, such farmers as water their meadows have an opportunity of selling their hay almost at any price to their neighbours.

Land treated in this manner is continually improving in quality, even though it be mown every year : the herbage, if coarse at first, becomes finer ; the soil, if swampy, becomes sound ; the depth of its mould is augmented, and its quality meliorated every year. "To these advantages (says Mr Boswell in his treatise upon this subject) another may be addressed to the gentleman who wishes to improve his estate, and whose benevolent heart prompts him to extend a charitable hand to the relief of the industrious poor, and not to idleness and vice : almost the whole of the expence in this mode of cultivation is the actual manual labour of a class of people who have no genius to employ their bodily strength otherwise for their own support and that of their families ; consequently when viewed in this light, the expence can be but comparatively small, the improvement great and valuable."

As a proof of the above doctrine, Mr. Wright adduces an instance of one year's produce of a meadow in his neighbourhood. It had been watered longer than the eldest person in the neighbourhood could remember ; but was by no means the best meadow upon the stream, nor was the preceding winter favourable for watering. It contains six acres and a half. The spring feed was let for seven guineas, and supported near 200 sheep from the 1st of March till the beginning

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Land con-
stantly im-
proves by
watering.

Example of
the produce
of a water-
ed meadow.

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ning of May: the hay being fold for 30 guineas, and the after-math for six. Another and still more remarkable proof of the efficacy of watering is, that two of the most skilful watermen of that place were sent to lay out a meadow of seven acres, the whole crop of which was that year fold for two pounds. Though it was thought by many impossible to throw the water over it, yet the skill of the workmen soon overcame all difficulties; and ever since that time the meadow has been let at the rent of three pounds per acre. From manifold experience, our author informs us, that the people in that part of the country are so much attached to the practice of watering, that they never suffer the smallest spring or rivulet to be unemployed. Even those temporary floods occasioned by sudden showers are received into proper ditches, and spread equally over the lands until their fertilizing property be totally exhausted. "Necessity (says he) indeed compels us to make the most of every drop: for we have near 300 acres in this parish, that must all, if possible, be watered; and the stream that affords the water seldom exceeds five yards in breadth and one in depth: therefore we may say, that a scarcity of water is almost as much dreaded by us as by the celebrated inhabitants of the banks of the Nile."

The practice of watering ought to be more generally extended.

Considering the great advantages to be derived from the practice of watering meadows, and the many undoubted testimonies in its favour, Mr Wright expresses his surprise, that it has not come into more general use, as there is not a stream of water upon which a mill can be erected but what may be made subservient to the enriching of some land, perhaps to a great quantity. "I am confident (says he), that there are in each

each county of England and Wales 2000 acres upon an average which might be thus treated, and every acre increased at least one pound in annual value. The general adoption therefore of watering is capable of being made a national advantage of more than 100,000*l.* per annum, besides the great improvement of other land arising from the produce of the meadows and the employment of the industrious poor. Such an improvement, one would think, is not unworthy of public notice; but if I had doubled the sum, I believe I should not have exceeded the truth, though I might have gone beyond the bounds of general credibility. In this one parish where I reside there are about 300 acres now watered; and it may be easily proved that the proprietors of the land reap from thence 1000*l.* yearly profit."

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In Mr Boswell's treatise upon this subject, published in 1790, the author complains of the neglect of the practice of improving the wet, boggy, and rushy lands, which lie at the banks of rivers, and might be meliorated at a very small expence, when much larger sums are expended in the improvement of barren uplands and large tracts of heath in various parts of the kingdom: and he complains likewise of the little information that is to be had in books concerning the method of performing this operation. The only author from whom he acknowledges to have received any information is Blyth; and even his method of watering is very different from that practised in modern times; for which reason he proposes to furnish an original treatise upon the subject; and of this we shall now give the substance.

The first thing to be considered is, what lands are capable

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 Land ca-
pable of
being wa-
tered.

 capable of being watered. These, according to Mr Boswell, are all such as lie low, near the banks of rivulets and springs, especially where the water-course is higher than the lands, and kept within its bounds by banks. If the rivulet has a quick descent, the improvement by watering will be very great, and the expences moderate. On level lands the water runs but slowly, which is also the case with large rivers; and therefore only a small quantity of ground can be overflowed by them in comparison of what can be done in other cases: but the water of large rivers is generally possessed of more fertilizing properties than that of rivulets. In many cases, however, the rivers are navigable, or have mills upon them; both of which are strong objections to the perfect improvement of lands adjacent to them. From these considerations, our author concludes, that the watering of lands may be performed in the best and least expensive manner by small rivulets and springs.

There are three kinds of soils commonly found near the banks of rivers and rivulets, the melioration of which may be attempted by watering. 1. A gravelly or sound warm firm soil, or a mixture of the two together. This receives an almost instantaneous improvement; and the faster the water runs over it the better. 2. Boggy, miry, and rushy soils, which are always found by the banks of rivers where the land is nearly level. These also are greatly improved by watering; perhaps equally so with those already described, if we compare the value of both in their unimproved state, this kind of ground being scarce worth any thing in its unimproved state. By proper watering, however, it may be made to produce large crops of

of hay, by which horned cattle may be kept through the winter and greatly forwarded; though, in its uncultivated state, it would scarce produce any thing to maintain stock in the winter, and very little even in summer. Much more skill, as well as expence, however, is requisite to bring this kind of land into culture than the former. 3. The soils most difficult to be improved are strong, wet, and clay soils; and this difficulty is occasioned both by their being commonly on a dead level, which will not admit of the water running over them; and by their tenacity, which will not admit of draining. Even when the utmost care is taken, unless a strong body of water is thrown over them, and that from a river the water of which has a very fertilizing property, little advantage will be gained; but wherever such advantages can be had in the winter, and a warm spring succeeds, these lands will produce very large crops of grafs.

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The advantage of using springs and rivulets for watering instead of large rivers is, that the expence of raising wares across them will not be great; nor are they liable to the other objections which attend the use of large rivers. When they run through a cultivated country also, the land floods occasioned by violent rains frequently bring with them such quantities of manure as contribute greatly to fertilize the lands, and which are totally lost where the practice of watering is not in use.

Springs and
rivulets
preferable
to large
rivers.

Springs may be useful to the coarse lands that lie near them, provided the water can be had in sufficient quantity to overflow the lands. " By springs (says our author), are not here meant such as rise out of poor heath or boggy lands (for the water issuing from them

Culture of them is generally so small in quantity, and always so
Grafs. very lean and hungry in quality, that little if any advantage can be derived from it ; but rather the head of rivulets and brooks rising out of a chalky and gravelly found firm soil, in a cultivated country. These are invaluable ; and every possible advantage should be taken to improve the ground near them. The author knows a considerable tract of meadow-land under this predicament ; and one meadow in particular that is watered by springs issuing immediately out of such a soil, without any advantage from great towns, &c. being situated but a small distance below the head of the rivulet, and the rivulet itself is fed all the way by springs rising out of its bed as clear as crystal. The soil of the meadow is a good loam some inches deep, upon a fine springy gravel. Whether it is from the heat of the springs, or whether the friction by the water running over the soil raises a certain degree of warmth favourable to vegetation, or from whatever cause it arises, the fecundity of this water is beyond conception ; for when the meadow has been properly watered and well drained, in a warm spring, the grafs has been frequently cut for hay within five weeks from the time the stock was taken out of it, having eaten it bare to the earth : almost every year it is cut in six weeks, and the produce from one to three waggon loads to an acre. In land thus situated, in the mornings and evenings in the months of April, May, and June, the whole meadow will appear like a large furnace : so considerable is the steam or vapour which arises from the warmth of the springs acted upon by the sun-beams : and although the water is so exceedingly clear, yet upon its being thrown over the land only

ly a few days in warm weather, by dribbling through the grafs, fo thick a fcum will arife and adhere to the blades of the grafs, as will be equal to a considerable quantity of manure fspread over the land, and (it may be prefumed from the good effects) ftill more enriching.

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“ It is inconceivable what 24 hours water properly conveyed over the lands will do in fuch a feafon : a beautiful verdure will arife in a few days where a parched rufty foil could only be feen ; and one acre will then be found to maintain more ftock than ten could do before.”

Mr Bofwell next proceeds to an explanation of the terms ufed in this art ; of the inftruments neceffary to perform it ; and of the principles on which it is founded. The terms ufed are :

Explana-
tion of the
terms ufed
in water-
ing.

1. A *Ware*. This is an erection acrofs a brook, rivulet, or river, frequently conftituted of timber, but more commonly of bricks or ftones and timber, with openings to let the water pafs, from two to ten in number according to the breadth of the ftream : the height being always equal to the depth of the ftream compared with the adjacent land. The ufe of this is occafionally to ftop the current, and to turn it afide into the adjacent lands.

2. A *Sluice* is conftituted in the fame manner as a ware ; only that it has but a fingle paffage for the water, and is put acrofs fmall ftreams for the fame purpofes as a ware.

3. A *Trunk* is defigned to anfwer the fame purpofes as a sluice ; but being placed acrofs fuch ftreams as either cattle or teams are to pafs over, or where it is neceffary to carry a fmall ftream at right angles to a large

Culture of large one to water some lands lower down, is for these
 Grafs. reasons made of timber, and is of a square figure. The length and breadth are various, as circumstances determine.

4. A *Carriage* is made of timber or of brick. If of timber, oak is the best; if of brick, an arch ought to be thrown over the stream that runs under it, and the sides bricked up: But when made of timber, which is the most common material, it is constructed with a bottom and sides as wide and high as the main in which it lies. It must be made very strong, close, and well jointed. Its use is to convey the water in one main over another, which runs at right angles to it; the depth and breadth are the same with those of the main to which it belongs: and the length is determined by that which it crosses. The carriage is the most expensive instrument belonging to watering.

5. A *Drain-fluice*, or *drain-trunk*, is always placed in the lower part of some main, as near to the head as a drain can be found; that is, situated low enough to drain the main, &c. It is made of timber, of a square figure like a trunk, only much smaller. It is placed with its mouth at the bottom of the main, and let down into the bank; and from its other end a drain is cut to communicate with some trench-drain that is nearest. The dimensions are various, and determined by circumstances. The use of it is, when the water is turned some other way, to convey the leaking water that oozes through the hatches, &c. into the drain, that otherwise would run down into the tails of those trenches which lie lowest, and there poach and rot the ground, and probably contribute not a little to making it more unsound for sheep. This operation is of the utmost
 consequence

consequence in watering; for if the water be not thoroughly drained off the land, the soil is rotted; and when the hay comes to be removed, the wheels of the carriages sink, the horses are mired, and the whole load, sometimes sticks fast for hours together. On the other hand, when the drain trunks are properly placed, the ground becomes firm and dry, and the hay is speedily and easily removed.

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7. *Hatches* are best made of oak, elm, or deal; the use of them is to fit the openings of wares, trunks, or sluices; and to keep back the water, when necessary, from passing one way, to turn it another. They ought to be made to fit as close as possible. When hatches belong to wares that are erected across large streams, or where the streams swell quickly with heavy rains, when the hatches are in their places to water the meadows they are sometimes made so, that a foot or more of the upper part can be taken off, so that vent may be given to the superfluous water, and yet enough retained for the purpose of watering the meadows. In this case, they are called *flood-hatches*: but Mr Boswell entirely disapproves of this construction, and recommends them to be made entire, though they should be ever so heavy, and require the assistance of a lever to raise them up. For when the water is very high, and the hatches are suddenly drawn up, the water falls with great force upon the bed of the ware, and in time greatly injures it: but when the whole hatch is drawn up a little way, the water runs off at the bottom, and does no injury.

8. A *head-main*, is a ditch drawn from the river, rivulet, &c. to convey the water out of its usual current, to water the lands laid out for that purpose, by

Culture of means of lesser mains and trenches. The head-main is
 Grafts. made of various dimensions, according to the quantity of land to be watered, the length or descent of it, &c. Smaller mains are frequently taken out of the head one; and the only difference is in point of size, the secondary mains being much smaller than the other. They are generally cut at right angles, or nearly so, with the other, though not invariably. The use of the mains, whether great or small, is to feed the trenches with water, which branch out into all parts of the meadow, and convey the water to float the land. By some, these smaller mains are improperly called *carriages*.

9. A *trench* is a small ditch made to convey the water out of the mains for the immediate purpose of watering the land. It ought always to be drawn in a straight line from angle to angle, with as few turnings as possible. It is never deep, but the width is in proportion to the length it runs, and the breadth of the plane between that and the trench-drain. The breadth tapers gradually to the lower end.

10. A *trench-drain* is always cut parallel to the trench, and as deep as the tail-drain water will admit, when necessary. It ought always, if possible, to be cut down to a stratum of sand, gravel, or clay. If into the latter, a spade's depth into it will be of great advantage. The use of it is to carry away the water immediately after it has run over the panes from the trench. It need not be drawn up to the head of the land by five, six, or more yards, according to the nature of the soil. Its form is directly the reverse of the trench; being narrow at the head, and growing gradually wider and wider until it empties itself into the tail-drain.

11. The *tail-drain* is designed as a receptacle for all the water that flows out of the other drains, which are so situated that they cannot empty themselves into the river. It would run, therefore, nearly at right angles with the trenches, though generally it is thought most eligible to draw it in the lowest part of the ground, and to use it to convey the water out of the meadows at the place where there is the greatest descent; which is usually in one of the fence-ditches; and hence a fence-ditch is usually made use of instead of a tail-drain, and answers the double purpose of fencing a meadow, and draining it at the same time.

12. A *pane* of ground is that part of the meadow which lies between the trench and the trench-drain; and in which the grafs grows for hay. It is watered by the trenches, and drained by the trench-drains; whence there is a pane on each side of every trench.

13. A *way-pane* is that part of the ground which lies in a properly watered meadow, on the side of the main where no trenches are taken out, but is watered the whole length of the main over its banks. A drain for carrying off the water from this pane runs parallel to the main. The use is to convey the hay out of the meadows, instead of the teams having to cross all the trenches.

14. A *bend* is made in various parts of those trenches which have a quick descent, to obstruct the water. It is made, by leaving a narrow strip of green sward across the trench where the bend is intended to be left; cutting occasionally a piece of the shape of a wedge out of the middle of it. The use is to check the water, and force it over the trench into the panes; which, were it not for these bends, would run rapidly on in the trench,

Culture of
Grass. and not flow over the land as it passes along. The great part of watering consists in giving to each part of the panes an equal proportion of water.

15. A *gutter* is a small groove cut out from the tails of these trenches where the panes run longer at one corner than the other. The use is to carry the water to the extreme point of the pane. Those panes which are intersected by the trench and tail-drains, meeting in an obtuse angle, require the assistance of gutters to convey the water to the longest side. They are likewise useful, when the land has not been so well levelled, but some parts of the panes lie higher than they ought: in which case, a gutter is drawn from the trench over that high ground, which otherwise would not be overflowed. Without this precaution, unless the flats be filled up (which ought always to be done when materials can be had to do it) the water will not rise upon it; and after the watering season is past, those places would appear rusty and brown, while the rest is covered with beautiful verdure. Our author, however, is of opinion, that this method of treating water meadows ought never to be followed; but that every inequality in water meadows should either be levelled or filled up. Hence the waterman's skill is shown in bringing the water over those places to which it could not naturally rise, and in carrying it off from those where it would naturally stagnate.

16. A *catch-drain* is sometimes made use of when water is scarce. When a meadow is pretty long, and has a quick descent, and the water runs quickly down the drains, it is customary to stop one or more of them at a proper place, till the water flowing thither rises so high as to strike back either into the tail-drains so as to stagnate

stagnate upon the sides of the panes, or till it flows over the banks of the drains, and waters the grounds below, or upon each side. It is then to be conveyed over the land in such quantity as is thought proper, either by a small main, out of which trenches are to be cut with their proper drains, or by trenches taken properly out of it. In case of a stagnation, the design will not succeed; and it will then be necessary to cut a passage to let the stagnating water run off. Even when the method succeeds best, Mr Boswell is of opinion, that it is not by any means eligible; the water having been so lately strained over the ground, that it is supposed by the watermen not to be endowed with such fertilizing qualities as at first; whence nothing but absolute necessity can justify the practice.

17. A *pond* is any quantity of water stagnating upon the ground, or in the tail-drain, trench-drains, &c. so as to annoy the ground near them. It is occasioned sometimes by the flats not having been properly filled up; at others, when the ware not being close shut, in order to water some grounds higher up, the water is thereby thrown back upon the ground adjacent.

18. A *turn* of water signifies as much ground as can be watered at once. It is done by shutting down the hatches in all those wares where the water is intended to be kept out, and opening those that are to let the water through them. The quantity of land to be watered at once must vary according to circumstances; but Mr Boswell lays down one general rule in this case, viz. that no more land ought to be kept under water at one time than the stream can supply regularly with a sufficient quantity of water; and if

Culture of this can be procured, water as much ground as possible.
 Grafs.

19. The *head* of the meadow is that part of it into which the river, main, &c. first enter.

20. The *tail* is that part out of which the river, &c. last passes.

21. The *upper side* of a main or trench, is that side which (when the main or trench is drawn at right angles, or nearly so, with the river) fronts the part where the river entered. The lower side is the opposite.

22. The *upper pane* in a meadow, is that which lies on the upper side of the main or trench that is drawn at right angles with the river: where the river runs north and south, it enters in the former direction, and runs out in the southern, the main and trenches running east and west. Then all those panes which lie on the north side of the mains are called *upper panes*; and those on the south side the *lower panes*. But when the mains, trenches, &c. run parallel to the river, there is no distinction of panes into upper and lower.

The instruments used in watering meadows are:

1. A *water-level*. The use of this is to take the level of the land at a distance, and compare it with that of the river, in order to know whether the ground can be overflowed by it or not. This instrument, however, is used only in large undertakings; for such as are on a smaller scale, the workmen dispense with it in the following manner: In draining a main, they begin at the head, and work deep enough to have the water follow them. In drawing a tail-drain, they begin at the lower end of it and work upwards, to let the tail

water

water come after them. By this method we obtain the most exact level. Culture of
Grass.

2. The *line*, *reel*, and *brest-plough*, are absolutely necessary. The line ought to be larger and stronger than that used by gardeners.

3. *Spades*. Those used in watering meadows are made of a particular form, on purpose for the work; having a stem considerably more crooked than those of any other kind. The bit is iron, about a foot wide in the middle, and terminating in a point: a thick ridge runs perpendicularly down the middle, from the stem almost to the point. The edges on both sides are drawn very thin, and being frequently ground and whetted, the whole soon becomes narrow; after which the spades are used for trenches and drains; new ones being procured for other purposes. The stems being made crooked, the workmen standing in the trench or drain are enabled to make the bottoms quite smooth and even.

4. *Wheel and hand-barrows*. The former are used for removing the clods to the flat places, and are quite open, without any sides or hinder part. The latter are of service where the ground is too soft to admit the use of wheel-barrows, and when clods are to be removed during the time that the meadow is under water.

5. *Three-wheeled carts* are necessary when large quantities of earth are to be removed; particularly when they are to be carried to some distance.

6. Short and narrow *scythes* are made use of to mow the weeds and grass, when the water is running in the trenches, drains, and mains.

7. *Forks* and long *crooks* with four or five tines, are

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used for pulling out the roots of sedges, rushes, reeds, &c. which grow in the large mains and drains. The crooks should be made light, and have long stems to reach wherever the water is so deep that the workmen cannot work in it.

8. Strong *water-boots*, the tops of which will draw up half the length of the thigh, are indispensably necessary. They must also be large enough to admit a quantity of hay to be stuffed down all round the legs, and be kept well tallowed to resist the running water for many hours together.

Principles
on which
the prac-
tice of wa-
tering de-
pends.

The principles on which the practice of watering meadows depend are few and easy.

1. Water will always rise to the level of the receptacle out of which it is originally brought.

2. There is in all streams a descent greater or smaller; the quantity of which is in some measure shown by the running of the stream itself. If it run smooth and slow, the descent is small; but if rapidly and with noise, the descent is considerable.

3. Hence if a main be taken out of the river high enough up the stream, water may be brought from that river to flow over the land by the side of the river, to a certain distance below the head of the main, although the river from whence it is taken should, opposite to that very place, be greatly under it.

4. Water, sunk under a carriage which conveys another stream at right angles over it, one, two, or more feet below its own bed, will, when it has passed the carriage, rise again to the level it had before.

5. Water conveyed upon any land, and there left stagnated for any length of time, does it an injury; destroying

destroying the good herbage, and filling the place with rushes, flags, and other weeds.

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6. Hence it is absolutely necessary, before the work is undertaken, to be certain that the water can be thoroughly drained off.

In Mr Wright's treatise upon this subject, the author considers a solution of the three following questions as a necessary preliminary to the operation of watering. 1. Whether the stream of water will admit of a temporary dam or ware across it? 2. Can the farmer raise the water by this means a few inches above its level, without injuring his neighbour's land? 3. Can the water be drawn off from the meadow as quick as it is brought on? If a satisfactory answer can be given to all these questions, he directs to proceed in the following manner.

Wright's
method.

Having taken the level of the ground, and compared it with the river, as directed by Mr Boswell, cut a deep wide ditch as near the dam as possible, and by it convey the water directly to the highest part of the meadow; keeping the sides or banks of the ditch of an equal height, and about three inches higher than the general surface of the meadow. Where the meadow is large, and has an uneven surface, it will sometimes be necessary to have three works in different directions, each five feet wide, if the meadow contains 15 acres, and if the highest part be farthest from the stream. A ditch of 10 feet wide and three deep will commonly water 10 acres of land. When there are three works in a meadow, and flood-hatches at the mouth of each, when the water is not sufficient to cover the whole completely at once, it may be watered at three different times, by taking out one of the hatches,

Culture of
Grass. hatches, and keeping the other two in. In this case, when the water has run over one division of the land for 10 days, it may then be taken off that and tumbled over to another, by taking up another hatch and letting down the former; by which means the three divisions will have a proper share of the water alternately, and each reap equal benefit. The bottom of the first work ought to be as deep as the bottom of the river, when the fall in the meadow will admit of it; for the deeper the water is drawn, the more mud it carries along with it. From the works cut, at right angles, small ditches or troughs, having a breadth proportioned to the distance to which some part of the water is to be carried, their distance from each other being about 12 yards. A trough two feet wide and one foot deep, will water a surface 12 yards wide and 40 feet long. In each trough as well as ditch place frequent stops and obstructions, especially when the water is rapid, to keep it high enough to flow through the notches or over the sides. Each ditch and trough is gradually contracted in width, as the quantity of water constantly decreases the farther they proceed. Between every two troughs and at an equal distance from both, cut a drain as deep as you please parallel to them, and wide enough to receive all the water that runs over the adjacent lands, and to carry it off into the master-drain with such rapidity as to keep the whole sheet of water in constant motion; and if possible, not to suffer a drop to stagnate upon the whole meadow. "For a stagnation, says he, (though it is recommended by a Mr D. Young for the improvement of arable land), is what we never admit in our system of watering; for we find that it rots the turf,

foaks

soaks and starves the land, and produces nothing but coarse grafs and aquatic weeds.

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“ When a meadow lies cold, flat, and swampy, the width of the bed, or the distance between the trough and drain, ought to be very small, never exceeding fix yards: indeed, in this case, you can scarcely cut your land too much, provided the water be plentiful; for the more you cut, the more water you require. The fall of the bed in every meadow should be half an inch in a foot: less will do, but more is desirable; for when the draught is quick, the herbage is always fine and sweet. The water ought never to flow more than two inches deep, nor less than one inch, except in the warm months.”

Mr Wright proceeds next to answer some objections made by the Reviewers in their account of the first edition of his work. 1. That the Gloucestershire farmers use more water for their lands than is necessary. To this it is answered, That where water is plentiful, they find it advantageous to use even more water than he recommends; and when water is scarce, they choose rather to water only one half, or even a smaller portion of a meadow at a time, and to give that a plentiful covering, than to give a scanty one to the whole. 2. The Reviewers likewise recommend a repeated use of the same water upon different and lower parts of the same meadow, or to make each drain serve as a trough to the bed which is below it. But though this method is, in some degree, recommended by the celebrated Mr Bakewell, and taught by a systematic waterer in Staffordshire, he entirely disapproves of it; excepting where the great declivity of the land will not admit of any other plan. “ This cannot (says he) be

Objections
to his method answered.

A repeated use of the same water is not eligible.

Culture of be a proper mode of watering grass-land in the win-
Grass. ter time; for it can be of no service to the lowest parts of the meadow, unless as a wetting in spring or summer. The first or highest part of a meadow laid out according to this plan will indeed be much improved; the second may reap some benefit; but the third, which receives the exhausted thin cold water, will produce a very unprofitable crop. Our farmers never choose more than a second use in the same meadow, and that very seldom; they call even the second running by the significant name of *small beer*; which, they say, may possibly satisfy thirst, but can give very little life or strength to land. It is a much better method to have a meadow laid out so as to be watered at several times, and to be at the expence of several small flood-hatches, than to water the whole of it at once by means of catch-drains.

“ Sometimes it is necessary, in a large meadow, to convey the water that has been used under the works and troughs; and then the water above is supported by means of boards and planks, which we call a *carry-bridge*. Sometimes, the better to regulate the course of the water on the surface, especially in the spring, narrow trenches are dug, and the mould laid by the side of them, in order to be restored to its former place when the watering is finished. The earth and mud thrown out in cleansing and paring the ditches should be carried to fill up the low hollow parts of the meadow, and be trodden down with an even surface; which will easily be done when the water is on, the waterman being always provided with a strong pair of water-proof boots. If the mould thus used has upon it a turf that is tolerably fine, place it uppermost; but
 if

if it is sedgy and coarse, turn it under, and the water Culture of
Grass. if it runs quick will soon produce a fine herbage upon it.

“The grounds that are watered in the easiest and most effectual manner, are such as have been ploughed and ridged up in lands about twelve yards wide. Here the water is easily carried along the ridge by means of a small ditch or trough cut along its summit, and then, by means of the stops in it, is made to run down the sides or beds into the furrows, by which it is carried into the master-drain, which empties itself into the river. Every meadow, before it is well watered, must be brought into a form something like a field that has been thus left by the plough in a ridged state. Each side of the ridge should be as nearly as possible an exact inclined plane, that the water may flow over it as equally as may be.” Mr Wright does not, like Mr Boswell, disapprove of the use of flood-hatches; he only gives the following hint, viz. that their basis should be deep and firmly fixed, well secured with stone and clay, that it be not blown up. The following directions are given for each month of watering.

In the beginning of November, all the ditches, Of cleaning
and repair-
ing the
works. troughs, and drains, are to be thoroughly cleansed by the spade and breast-plough, from weeds, grass, and mud; and well repaired, if they have received any injury from cattle. After a shower, when the water is Thick and
muddy wa-
ter to be
used when
it can be
done. thick and muddy, turn over the meadow as much water as you can without injuring the banks of the works, especially if the land be poor; as in this month, according to our author, the water contains many more fertilizing particles, which he calls *salts* and *richness*, than later in the winter. In defence of this position,
of

Culture of
Grass. of which it seems the Monthly Reviewers have doubted, our author urges, that though he is not able to prove it by any chemical analysis, yet it seems evident, that "after the first washing of farm yards, various sinks, ditches, and the surface of all the adjoining fields, which have lain dry for some time, the common stream should then contain much more fatness than when the same premises have been repeatedly washed." This is confirmed by the experience of the Gloucestershire farmers; who, if they can at this season of the year procure plenty of muddy water to overflow their grounds for one week, look upon it to be equally valuable with what is procured during all the rest of the winter. In support of this, he quotes the following words of Mr Forbes, in a treatise on watering: "The water should be let in upon the meadow in November, when the first great rains make it muddy, for then it is full of a rich sediment, brought down from the lands of the country through which it runs, and is washed into it by the rain; and as the sediment brought by the first floods is the richest, the carriages and drains of the meadow should all be scoured clean and in order, before these floods come."

"In opposition (adds Mr Wright) to the opinion of speculative waterers, that the muddiness of the water is of little consequence, I hesitate not to affirm, that the mud is of as much consequence in winter-watering, as dung is in the improvement of a poor upland field. For each meadow in this neighbourhood is fruitful in proportion to the quantity of mud that it collects from the water. And, indeed, what can be conceived more enriching than the abundant particles of putrid matter which float in the water, and are distributed over
the

the surface of the land, and applied home to the roots of the grafs. It is true, that any the most simple water thrown over a meadow in proper quantity, and not suffered to stagnate, will shelter it in winter, and in the warmth of spring will force a crop; but this unusual force must exhaust the strength of the land, which will require an annual supply of manure in substance, or, in a course of years, the soil will be impaired rather than improved. The meadows in this county, which lie next below a market town or village, are invariably the best; and those which receive the water after it has been two or three times used, reap proportionably less benefit from it: For every meadow that is well laid out, and has any quantity of grafs upon its surface, will act as a fine sieve upon the water, which, though it flow in ever so muddy, will be returned back to the stream as clear as it came from the fountain. This circumstance, when there is a range of meadows to be watered, the property of different persons, when water is scarce, creates vehement contentions and struggles for the first use of it. The proprietors are therefore compelled to agree among themselves, either to have the first use alternately, or for the higher meadows to dam up, and use only one half or a less portion of the river. Our farmers know the mud to be of so much consequence in watering, that whenever they find it collected at the bottom of the river, or the ditches, they hire men whole days to disturb and raise it with rakes made for the purpose, that it may be carried down by the water, and spread upon their meadows. One meadow in South Cerncy, I think, is an incontestable proof of the consequence of muddy water. It is watered by a branch of the common stream that runs for about half

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Instance of
the good
effects of
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a mile down a public road. This water, by the mud being continually disturbed by carriages and the feet of cattle, becomes very thick, and when it enters the meadow is almost as white as milk. This field, which consists of seven acres, was a few years ago, let for 10s. an acre; but is already become the richest land in the parish, and has produced at one crop eighteen loads of hay, and each load more than 25 hundred weight.

Mr Wim-
pey's opi-
nion upon
the sub-
ject.

In further confirmation of what our author asserts, he quotes, from the Annals of Agriculture, the following words of Mr Wimpey: "As to the sorts of water, little is to be found, I believe, which does not encourage and promote vegetation, even the most simple, elementary, and uncompounded fluid: heat and moisture, as well as air, are the *sine qua non* of vegetation as well as animal life. Different plants require different proportions of each to live and flourish; but some of each is absolutely necessary to all. However, experience as well as reason universally shows, that the more turbid, feculent, and replete with putrescent matter the water is, the more rich and fertilizing it proves. Hasty and impetuous rains, of continuance sufficient to produce a flood, not only dissolve the salts, but wash the manure in substance off the circumjacent land into the rapid current. Such turbid water is both meat and drink to the land; and, by the unctuous sediment and mud it deposite, the soil is amazingly improved and enriched. The virtue of water from a spring, if at all superior to pure elementary water, is derived from the several strata or beds of earth it passes through, which, according to the nature of such strata, may be friendly or otherwise to vegetation. If it passes through chalk, marl, fossil shells, or any thing
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of a calcareous nature, it would in most soils promote the growth of plants; but if through metallic ores, or earth impregnated with the vitriolic acid, it would render the land unfertile, if not wholly barren. In general, the water that has run far is superior to that which immediately flows from the spring, and more especially ~~that~~ which is feculent and muddy, consisting chiefly of putrid animal substances washed down the stream." Culture of
Grafts.

To the same purpose also says Mr Forbes: "There is great difference in the quality of waters, arising from the particles of different kinds of matter mixed with them. Those rivers that have a long course through good land, are full of fine particles, that are highly fertilizing to such meadows as are usually overflowed by them; and this chiefly in floods, when the water is fullest of a rich sediment: for when the water is clear, though it may be raised by art high enough to overflow the adjoining lands, and be of some service to them, the improvement thus made is far short of what is obtained from the same water when it is thick and muddy." Confirmed
by Mr Forbes.

Mr Boswell, though quoted by Mr Wright as an advocate for the doctrine just now laid down, seems, in one part of his work at least, to be of a contrary opinion. This is in the 14th chapter of his book, where he remarks upon another publication on the same subject, the name of which he does not mention: "In page 4. of that pamphlet (says Mr Boswell), the writer informs us, 'if the water used be always pure and simple, the effect will by no means be equal to the above; that is, of a stream that is sometimes thick and muddy. We have a striking instance of this in two of our meadows, which are watered immediately from

Culture of
Grafs. springs that arise in the grounds themselves. Their crops are early and plentiful, but not of a good quality, and the land remains unimproved after many years watering.'

"The writer of this treatise (Mr Boswell), in a former edition, had asserted, and in this repeated, the contrary effects from a stream very near the spring-head, as clear as crystal.

"The gentleman (Mr Beverly of Keld) whom that writer mentions in his preface, made a short visit into Dorsetshire, to satisfy himself of the fact. The editor had the pleasure to show him the stream alluded to, which he traced almost to the fountain-head. It was perfectly clear, and the water was then immediately conveyed out of the stream upon the lands adjoining, some of which it was then running over; others it had been upon, and the verdure was then appearing. The gentleman expressed himself perfectly satisfied with the fact. To him the editor wishes to refer, &c. Mr George Culley of Fenton near Wooler in Northumberland, with a truly noble and public spirit that does him great honour as a friend to his country, sent a very sensible young man from thence into Dorsetshire, to learn the art of watering meadows, and to work the whole season in those meadows under different watermen. This man was often over those meadows, and worked in some just below that were watered by the same stream. Might the editor presume to offer his opinion upon this seeming contradiction, it is very probable that the soils, both the upper and under strata, are very different, as well as those through which the different springs run."

From this passage, the latter part of which is not very

very intelligible, we might conclude that Mr Boswell ^{Culture of} prefers clear to muddy water for overflowing meadows. ^{Grafs.}
 In his chapter on land-floods, however, he expresses ^{Advanta-} himself as follows: "They will (says he) always be ^{ges of land-} found of great use where the sweepings of towns, farm- ^{floods.} yards, &c. are carried down by them; seldom any other erection is wanting besides a sluice or small ware to divert and convey them over the lands. If the situation of the land happen to be on the side of a hill, catch-drains are absolutely necessary for watering the lower part of the hill, after the water has been used upon the upper. In many parts of the kingdom, where there are large hills or extensive rising lands, great quantities of water run from them into the valleys after heavy rains: These might with proper attention be collected together before they get to the bottom or flat ground, and from thence be diverted to the purpose of watering those lands that lie below, with great advantage to the occupier, and at a small expence. And should the land thus situated be arable, yet it would be found a beneficial exchange to convert it into pasture; particularly if ^{Of convert-} pasture-ground should be a desirable object to the occu- ^{ing arable} pier. The method of performing it is thus recommend- ^{land into} ed. Observe the piece of land or field best adapted to the purpose, both for situation and soil. If it should be arable, make it first very level; and with the crop of corn sow all sorts of hay feeds; and as soon as it has got a green sward it may be laid out. In the lowest part of the ground draw a deep ditch for the current to run in through it; and continue it into some ditch or low part in the lands below, that the water may be freely carried off, after it has been and while it is in use. Draw ditches above the field intended to be

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watered, aslant the sides of the hill, in such a manner that they may all empty themselves into the head of the ditch above mentioned, just where it enters the field to be watered; then erecting a ware across this ditch, the field will be capable of being watered, according to the situation of the ditch in the middle or on the side of the field. It must then be conveyed by small mains or trenches, and subdivided again by branch-trenches, according to the site of the field and quantity of water that can be collected; trench-drains must be drawn, and the water conveyed into the ditch by means of tail-drains. A person unacquainted with water-meadows cannot conceive the advantage arising from water thus collected and conveyed over this species of water-meadow (if it may be so called), being generally a firm good soil; but the water running down from rich cultivated hills, eminences, &c. sweeps away with it, when the rain falls very heavy, vast quantities of dung dropped by sheep and other cattle, and the manure carried upon arable lands; all which being now diverted, and carried over the meadow with an easy descent, gives time for the particles of manure to subside upon the ground at one season, or of being filtered from it as it dribbles through the grafs at another; after which the warm weather pushes on vegetation amazingly. Meadows thus situated would be vastly superior to any other, if they had the advantage of a constant stream; but even as they are, taking the opportunity of watering them by every heavy rain or flood that happens, they will be found to be very valuable. The occupier of such lands is strenuously advised to let no time be lost in appropriating them to this use; because these lands are healthy for all kinds
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of cattle at almost all seasons; and the expence of converting them into this kind of water-meadow is exceeding small, the annual charges afterwards quite trifling, and the produce very considerable.”

Mr Wright, having discussed the subject of the quality of the water, proceeds to give directions for watering through the different months of the year;—<sup>Culture of
Grass.</sup> “In December and January, the chief care consists in keeping the land sheltered by the water from the severity of frosty nights. It is necessary, however, through the whole winter, every ten days or fortnight, to give the land air, by taking the water off entirely, otherwise it would rot and destroy the roots of the grass. It is necessary, likewise, that a proper person should go over every meadow at least twice every week, to see that the water is equally distributed, and to remove all obstructions arising from the continual influx of weeds, leaves, sticks, and the like. In February, a great deal depends upon care and caution. If you now suffer the water to remain on the meadow for many days without intermission, a white scum is raised, very destructive to the grass; and if you take off the water, and expose the land to a severe frosty night, without its being previously dried for a whole day, the greatest part of the tender grass will be cut off. The only ways to avoid both these injuries are, either to take the water off by day to prevent the scum, and to turn it over again at night to guard against the frost; or, if this practice be too troublesome, both may be prevented by taking the water entirely off for a few days and nights, provided the first day of taking off be a dry one; for if the grass experience one fine drying day, the frost at night can do little or no injury. The scum

Culture of is generated chiefly by the warmth of the sun, when the
Grafs. water is thin and used too plentifully. Towards the middle of this month we vary our practice in watering, by using only about half the quantity of water which is made use of earlier in the winter; all that is now required being to keep the ground in a warm moist state, and to force vegetation.

“ At the beginning of March, the crop of grafs in the meadows is generally sufficient to afford an abundant pasturage for all kinds of stock, and the water is taken off for near a week, that the land may become dry and firm before the heavy cattle are turned in.— It is proper, the first week of eating off the spring-feed, if the season be cold, to give the cattle a little hay each night.”

Of eating
 off the
 spring-grafs
 with ewes
 and lambs.

“ It is a custom (says Mr Wright) with some farmers in Hampshire to eat off the spring grafs of their meadows with ewes and lambs, in the same manner that we do a field of turnips, by enclosing a certain portion each day with hurdles or stakes, and giving them hay at the same time. This is certainly making the most of the grafs, and an excellent method to fine and sweeten the future herbage. In this month and April, you may eat the grafs as short and close as you please, but never later; for if you trespass only one week on the month of May, the hay-crop will be very much impaired, the grafs will become soft and woolly, and have more the appearance and quality of an after-math than a crop. At the beginning of May, or when the spring feeding is finished, the water is again used for a few days by way of wetting.

“ It is rather remarkable, that watering in autumn, winter, or spring, will not produce that kind of herbage

bage which is the cause of the rot in sheep; but has been known to remove the cause from meadows, which before had that baneful effect. If, however, you use the water only a few days in any of the summer months, all the lands thus watered will be rendered unsafe for the pasturage of sheep. Of this I was lately convinced from an experiment made by a friend. At the beginning of July, when the hay was carried off, and the water rendered extremely muddy and abundant by several days rain, he thought proper to throw it over his meadows for ten days, in which time a large collection of extremely rich manure was made upon the land. In about a month the meadow was covered with uncommon luxuriance and blackness of herbage. Into this grass were turned eight sound ewes and two lambs. In six weeks time the lambs were killed, and discovered strong symptoms of rottenness; and in about a month afterwards one of the ewes was killed, and though it proved very fat, the liver was putrid and replete with the insect called the *fluke* or *weevil*: the other ewes were sold to a butcher, and all proved unsound. This experiment, however, convinces me, by the very extraordinary improvement made thereby in the meadow, that muddy water in the summer is much more enriching than it is in autumn or winter; and ought, therefore, to be used for a week at least every wet summer, notwithstanding its inconveniences to sheep, the most profitable species of stock."

Mr Boswell, besides his general directions for watering, gives many plans of the ditches, drains, &c. for particular meadows, some of them done from an actual survey. But these being confined to particu-

Culture of
Grass. } lar situations, we shall here only speak of his method
Mr Ros- } in general. In his third chapter, entitled *A general*
well's ge- } *Description of Water-meadows*, he observes, that "lands
neral di- } capable of being watered, lie sometimes only on one
rection- } side, and sometimes on both sides of the stream designed
watering. } to supply them with water. In the former case, when

they have a pretty quick descent, the land may be often watered by a main drain out of the stream itself, without any ware;" though he acknowledges that it is by far the best way to erect a ware, and to draw mains on each side, to dispose of the water to the best advantage.

Boggy lands require more and longer continued watering than such as are sandy or gravelly; and the larger the body of water that can be brought upon them the better. The weight and strength of the water will greatly assist in compressing the soil, and destroying the roots of the weeds that grow upon it; nor can the water be kept too long upon it, particularly in the winter season; and the closer it is fed, the better.

To improve strong clay soils, we must endeavour to the utmost to procure the greatest possible descent from the trench to the trench-drain; which is best done by making the trench-drains as deep as possible, and applying the materials drawn out of them to raise the trenches. Then, with a strong body of water, taking the advantage of the autumnal floods, and keeping the water some time upon them at that season, and as often as convenient during the winter, the greatest improvement on this sort of soils may be made. Warm sand or gravelly soil, are the most profitable under the watering system, provided the water can be brought over them at pleasure. In soils of this kind, the water must not be kept long at a time, but often shifted, thoroughly

ly drained, and the land frequently refreshed with it : Culture of
Grass. under which circumstances the profit is immense. A spring-feeding, a crop of hay, and two after-maths, may be obtained in a year; and this, probably, where in a dry summer scarce grass enough could be found to keep a sheep alive. If the stream be large, almost any quantity of land may be watered from it; and though the expence of a ware over it is great, it will soon be repaid by the additional crop. If the stream is small, the expence will be so in proportion.

The following method of improving a water-meadow that was springy has been tried by Mr Boswell Method of
improving
a springy
water-meadow. with success. The meadow had been many years watered by a spring rising just above it from a barren sandy heath; the soil near the surface was in some places a gravelly sand, in others a spongy cork, both upon a strong clay and sand mixture, which retained the draining of the lands above it. Whenever it had been watered, and left to drain itself dry, a yellowish red water stood in many parts, and oozed out of others; the herbage being no other than a poor, miserable hairy grass and small sedge. Chalk and ashes had been thrown over it to very little purpose. It was then drained underground aslant all the different descents, and all these drains carried into one large drain, which had been already cut for the purpose of carrying off the water when the meadow was overflowed. These drains were cut quite through the mixture of clay and sand, and as much deeper as the fall of the ground below would admit of; then, with chalk cut for the purpose, small hollow drains were formed at the bottom of these; the drains were then filled up with the materials that came out.

This

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Grass.

This was done in the beginning of summer, and the work frequently examined through the season; the soil was found firmer than before, and none of that nasty red water to be met with upon the surface, though it continually oozed into the drains. In autumn the meadow was again prepared for waterings, by repairing those trenches and drains that were properly situated; and by cutting others where wanted, for the purpose of watering the meadow. The water being then brought over it from the same spring as before, the event answered the most sanguine wishes of the proprietor; the effects were visible the first year, and the ground has been constantly improving ever since.

Of water-
ing lands
on the side
of hills.

Mr Boswell also informs us, that a gentleman in Scotland had applied to him for directions to water some lands lying on the sides of hills, where the descent is quick; and of which there are many in this country, as well as in the north of England. It would be difficult, he thinks, to water such lands by means of drains and trenches according to the directions already given; because the bends in the trenches must be very near together and large, as the water must flow out of the trench above the bend to flow over the pane below it; the number and size would likewise be inconvenient, and greatly offend the eye.

Lands of this sort are generally capable of being ploughed; in which case our author directs them to be once ploughed in the spring, and sown with oats or any other kind of grain that will rot the sward. When the grain is harvested, plough the land across; the last ploughing with the Kentish plough, which has a moveable mouldboard, and is called a *turn-wrist* plough. This turns the furrows down the side of the hill,

hill, the horses going forwards and backwards in the same furrows. By this means the land is laid flat without any open furrows in it. Dress it down in the spring very fine, and sow it with oats, and mix with some kinds of grass seeds very thick. Thus the ground will have but few irregularities; and as soon as the corn is carried off, or the following spring at farthest, the mains and drains may be cut out.

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Grass.

For watering coarse lands that are firm enough to bear the plough, and situated near a stream, our author gives the following directions.

“ Let the land thus situated be ploughed once in the spring, and sown with any grain that will rot sward. As soon as the crop is off, plough it again, and leave it rough through the winter. Work it down early in the spring, and plough it in the direction the trenches are to lie, making the ridges of a proper size for watering, ten or twelve yards wide for instance; work it fine; then gather the ridges up again in the same manner, making the last furrows of each ridge as deep as possible. If the land be not fine, dress it down again, and gather it up a second time if necessary; and with a shovel throw the earth from the edges of the furrows to the tops of the ridges, to give the greatest possible descent from the trench to the drain. Sow it with oats and grass seeds very thick; and after the corn is carried off, the trenches may be formed upon the top of each ridge, dispersing the furrows with a spade as much as the fall of the land will admit of for the drains; taking care to procure sufficient fall at all events, to drain the lands after they have been watered. By this method the crop of corn will

Of water-
ing coarse
lands.

Culture of will nearly pay all the expence, and the land will be
 Grafts. in excellent order."

Of the ma-
 nagement
 of meadows
 after wa-
 tering.

After the work of watering a meadow is totally finished, and the hay carried off, cattle may be let in to eat the after-math. When this is done, it will then be necessary to examine whether or not the mains have suffered any injury from their feet; whether there be quantities of mud or sand collected at the angles, &c. all of which must be thrown out and the breaches repaired; by which means the trenches, drains, &c. will last three years, but otherwise not more than two. The roots, mud, &c. may be used in repairing the breaches, but never left upon the sides of the trenches out of which they are taken. The tail-drains require to be cleaned oftener than any of the other works, for this obvious reason, that the mud, &c. is carried down from all the others into them; where, if it be allowed to accumulate, it occasions a stagnation of water upon the meadow itself. In repairing the trenches, particular care ought to be taken that the workmen do not make them any wider than before, which they are very apt to do; neither are they to be allowed to throw the materials which they dig out in a ridge behind the edge of the trench, which both widens it, and promotes weeds.

Of the time
 the water
 should con-
 tinue upon
 the mea-
 dows.

During the time of watering, it will be necessary to examine the meadow every two or three days, in order to remove obstructions, &c. If the drains should be filled with water and run over, they ought to be made deeper; or if this cannot be done, they should be widened. In the winter time a regular strong water should be kept, avoiding very strong great floods. In this season the water may be kept on the ground with safety

safety for a month, or even six weeks, if the soil be corky or boggy, or a strong clay; but not quite so long if it be gravel or sand. At the second watering a fortnight or three weeks will be sufficient; and after Candlemas a fortnight will be rather too long. At the third watering a week will be sufficient, which will bring it to about the middle of March; by which time, if the weather be tolerably mild, the grass will be long enough for the ewes and lambs, or fattening lambs; which may then be turned into the meadow with great advantage. Even in the end of February, if the winter has been very mild, the grass will be long enough for them. Here they may be permitted to feed till the beginning of May, changing them into different meadows. As soon as they are taken out, the water must be turned in for a week, carefully examining every trench and drain for the reasons already given. The water is then to be shifted into others, alternately watering and draining, lessening the time the water remains upon it as the weather grows warmer; and in five, six, or seven weeks, the grass will be fit to be mown for hay, and produce from one to two tons, or even more, an acre, upon good ground.

Mr Boswell directs, that about a week before the grass is to be mown, the water should be let into the meadow for 24 hours; which he says, will make the ground moist at the bottom, the scythe will go through it the more easily, and the grass will be mown closer to the ground. This practice, however, is entirely disapproved of by Mr Wright. "Though it may prevail in Dorsetshire (says he), it is very seldom advisable, for the following reasons: Water made to run through a thick crop of grass, though it may appear

Culture of
Grass.

**Culture of
Grafts.** pear ever so pure, will leave a certain quantity of adherent scum or sediment, which can never be separated from the hay, but will render it unpalatable, if not prejudicial, to the cattle that eat it. And this wetting of the land and grafts will impede the drying or making of the hay perhaps some days, which in difficult seasons is of very great consequence, and it will likewise make the turf too soft and tender to support the wheels of a loaded waggon in carrying off the hay. Besides, there is reason to believe that one day's wetting in the summer, will, upon most meadows, endanger the soundness of every sheep that feeds upon the after-maths."

**Of spring-
feeding.**

The spring-feeding ought never to be done by heavier cattle than sheep or calves; for large cattle do much hurt by poaching the ground with their feet, destroying the trenches, and spoiling the grafts. Mr Boswell likewise greatly recommends a proper use of spring floods, from which he says much benefit may be derived; but, if there is any quantity of grafts in the meadows not eaten, these floods must be kept out, otherwise the grafts will be spoiled; for they bring with them such quantities of sand and mud, which stick to the grafts, that the cattle will rather starve than taste it. Great quantities of grafts or after-math are frequently spoiled in flat countries by the floods which take place in the fall. In the winter time, however, when the ground is bare, the sand and mud brought down by the floods is soon incorporated with the soil, and becomes an excellent manure. The certain rule with regard to this matter is, "Make use of the floods when the grafts cannot be used; avoid them when the grafts is long or soon to be cut."

"It

“ It has often been a subject of dispute (says Mr Bofwell), whether, from the latter end of autumn to Candlemas, the throwing a very strong body of water, where it can be done, over the meadows, is of any essential service or not? Those who consider it as advantageous, assert, that when the waters run rude and strong over the ground, they beat down and rot the turfs of foggy or rough grass, sedges, &c. that are always to be found in many parts of coarse meadow-ground; and therefore are of particular service to them. On the other side it is alleged, that by coming in so large a body, it beats the ground (in the weak places particularly) so bare, that the sward is destroyed; and also brings with it such quantities of seeds of weeds, that at the next hay season the land in all those bare places bears a large burden of weeds, but little grass.

Culture of
Grass.
Of water-
ing from
the end of
autumn to
Candlemas.

“ The general opinion of the watermen upon this point is, that in water-meadows which are upon a warm, sandy, or gravelly soil, with no great depth of loam upon them, rude strong watering, even in winter, always does harm, without any possible essential service. On the contrary, cold strong clay land will bear a great deal of water a long time without injury; and boggy, corky, or spongy soil, will also admit of a very large and strong body of water upon it with great advantage for almost any length of time at that season, provided the drains are made wide and deep enough to carry it off, without forcing back upon the end of the panes. The weight and force of the water vastly assists in compressing those soils, which only want solidity and tenacity to make them produce great burdens of hay: nothing, in their opinion, corrects and improves those soils so much

Culture of
Grafs. much as a very strong body of water, kept a considerable time upon them at that season."

Notwithstanding the above reasons, however, Mr Boswell informs us, that he has doubts upon the subject; nor can he by any means acquiesce in this opinion, unless, by rude strong waters he is permitted to understand only rather a larger quantity of water conveyed over the land at this early season than ought to be used in the spring or summer: unmanageable waters he believes always hurtful.

"It may be proper just to add (continues he), that as soon as the hay is carried off the meadows, cattle of any sort, except sheep, may be put to eat the grafs out of the trenches, and what may be left by the mowers. This perhaps will last them a week; when the water may be put into the meadows in the manner already described, taking care to mow the long grafs which obstructs the water in the trenches; and this mowing is best done when the water is in them. Let the weeds, leaves, &c. be taken out and put in heaps, to be carried away into the farm yards; examine the trenches, make up the breaches, &c. take particular care that the water only dribbles over every part of the panes as thin as possible, this being the warmest season of the year. The first watering should not be suffered to last longer than two or three days before it is shifted off (and, if the season be wet, perhaps not so long, as warmth seems to be the greatest requisite after the land is once wet to assist vegetation) to another part or meadow beat out by the cattle, by this time fit to take it. Do by this meadow exactly the same, and so by a third and fourth, if as many meadows belong to the occupier. Observe at all times, when the water is taken out of a meadow,

meadow, to draw up the drain-fluice hatches; as, without doing that, watering is an injury. By the time that three or four parts are thus regularly watered, the first will have an after-math, with such rich and beautiful verdure as will be astonishing; and both quantity and quality will be beyond conception better than if the lands had not been watered.

Culture of
Grais.

“Hence we see why every person should, if possible, have three or four meadows that can be watered; for here, while the cattle are eating the first, the second is growing, the third draining, &c. and the fourth under water. In this manner the after-math will in a mild season last till Christmas. A reason was given why the spring-grais should be fed only by sheep or calves; a reason equally cogent may be given, why the after-grais ought not to be fed by them, because it will infallibly rot them. No sheep (says our author), except those which are just fat, must ever be suffered even for an hour in water meadows, except in the spring of the year; and even then care must be taken that every part of the meadows have been well watered, and that they are not longer kept in them than the beginning of May. Although at present it is unknown what is the occasion of the rot, yet certain it is, that even half an hour’s feeding in unhealthy ground has often proved fatal. After a short time they begin to lose their flesh, grow weaker and weaker; the best feeding in the kingdom cannot improve them after they once fall away; and when they die, animalcula, like plaice, are found in the livers. Scarcely any ever recover from a slight attack; but when farther advanced, it is always fatal. Guard by all means against keeping the water too long upon the meadow in warm weather; it will very soon produce a

Water
ought not to
be kept too
long upon
meadows.

Culture of white substance like cream, which is prejudicial to the
Grafs. grafs, and shows that it has been too long upon the ground already. If it be permitted to remain a little longer, a thick scum will settle upon the grafs, of the consistence of glue, and as tough as leather, which will quite destroy it wherever it is suffered to be produced. The same bad effects seem to arise from rude waters; neither can the scum easily be got off.

Advantages of rolling meadows.

“Rolling meadows in the spring of the year is an excellent method. It should be done after Candlemas, when the meadow has been laid dry a week. It should be always rolled lengthwise of the panes, up one side of the trench and down the other. Rolling also contributes much to the grafs being cut close to the surface when mown, which is no small advantage; for the little hillocks, spewings of worms, ant-hills, &c. are by this means pressed close to the ground, which would otherwise obstruct the scythe and take off its edge; and to avoid that inconvenience, the workmen always mow over them.”

As a water-meadow has with so much justice been called a *hot-bed of grafs*, and as the practice of flooding tends so completely to ameliorate the poorest soils, and to extirpate heath and all coarse and woody plants, we are satisfied that the knowledge of it cannot be too extensively diffused, or too minutely inquired into. That it may be more clearly understood, therefore, we shall here give a statement of the mode in which it is practised in Gloucestershire, as explained from Mr Wright’s pamphlet, by the Rev. Mr Charles Findlater, in a letter to the conductors of the Farmer’s Magazine.

Watering explained by Mr Findlater.

Plate XIV. “Fig. 1. represents a float-meadow under irrigation; the dark shading representing the water.

“When

“ When the hatch of the water dam-dike (marked H) is lifted up, the water runs in the natural channel of the river ; when the hatch is shut, as represented in the figures, the natural channel is laid dry below it, and the water runs laterally along the main-feeder, in the direction of the arrows, and is from it distributed into the floating gutters (*g, g, g, g*), which are formed along the crowns of the ridges, into which the meadow is arranged, overflowing on both sides of said gutter, and running down the sides of the ridges into the furrows or drains betwixt the ridges (*d, d, d, d*), which drains discharge it into the main-drain, whereby it is returned into its natural channel at the foot of the meadow.

Culture of
Graft.

“ The marks (*oo*, or *Δ Δ*), and the tufts, in the main-feeder and the floating-gutters, denote—The first, obstructions (made by small stakes, or fods, or stones) to raise the water, and make it flow over from the main-feeder into the floating-gutters, or from the latter over the sides of the ridges ; the second, nicks, made in their sides, with a similar intention. If, however, the main-feeder and floating-gutters are properly constructed at their first formation, these supplementary aids will be, in a great measure, unnecessary : For the main-feeder ought, at its entrance, to be of dimensions just sufficient to admit the quantity of water which is to be conveyed to the meadow ; and gradually to contract its size as it goes along, in order that the water, for want of room, may be forced over its side, and into the floating-gutters : these last ought to be formed after the same model, that the water may, by their primary construction, overflow their sides, through their whole course. That as little as possible of the surface may be unproductive, a similar construction should be adopted

Culture of
Grass. for the drains; they ought to be narrow nearest to the main-feeder, where they receive little water, and to diverge as they approach the main-drain; which last is, for the same reason, similarly constructed. In the plan, this mode of construction is made obvious to the eye.

“ The meadow, in this plate, must be conceived to lie in a regular and very gentle slope from the main-feeder to the main-drain.

“ Fig. 2. and fig. 3. present a view of the ridges cut across, with the feeding-gutter (*g*) upon their crown, and the furrows, or discharging drains (*d, d*) along their sides. Fig. 3. shows the shape (or gradual slope) into which they ought to be formed at first, were it not for the expence, i. e. when they are to be formed out of grass fields, preserving the grass sward. Fig. 2. represents the mode in which they may, more cheaply, though more roughly, be formed at first; when, the depositions of sediment from the floating water will gradually fill the shoulders of the floating-gutters, up to the dotted line, forming the ridge into the shape of fig. 3.

“ In the formation of the meadow, (particularly if the declivity is very small), care should be taken to lose as little as possible of the level in the main-feeder, and in the floating-gutters; in order that the greater descent may be given to the water down the sides of the ridges, from the floating-gutters, to their discharging drains, that the water may float over the ridges sides with the more rapidity, and in the more quick succession.

“ The distance from the floating-gutter to the discharging-

charging-drain, ought not to be less than four yards, i. e. the breadth of the ridge eight yards; nor more than five yards and a half, i. e. the breadth of the ridge eleven yards. Culture of
Grass.

“ It is evident from the plan, that, when the hatch (H) is lifted up, the water resumes its natural channel, and the meadow becomes at once dry. Its figure frees it instantly of all surface water. If any of it is wet from springs, these must be carried off by under-draining; for it must be thoroughly drained before you can drown it to good effect.

“ This figure represents a float-meadow, where the declivity is unequal, and which, also, is too large for the command of water, to admit of being floated all at once.

“ In this meadow, it is supposed that the ground rises, from the natural channel of the river, up to (F 1.), which is a feeder, with its floating-gutters (*g, g, g, g*): and thence descends to the hollow (D 1.), which is a drain communicating with the main-drain, and receiving the water from the lesser drains or receiving furrows (*d, d, d*). It is supposed, that the ground rises again from the hollow (D 1.), up to the second feeder (F 2.); and thence descends again into the hollow, along which is conducted the receiving-drain (D 2.). The remainder of the meadow is supposed to lie in a regular slope, from the main-feeder to the drain last mentioned, and the main-drain. The letter (*r*) marks a very small rut, made with a spade, or triangular hoe, for conducting water to places upon which it appears not to scatter regularly.

“ The hatch upon the river's natural channel, and that upon the feeder (F 2.) are represented as shut; and,

**Culture of
Grass.** consequently the natural channel, together with that part of the meadow which is floated from the feeder (F 2.), as dry. The hatches upon the feeder (F 1.), and upon the main-feeder, are represented as drawn up; and, consequently the two parts of the meadow, floated from them, are represented as under water.

Fig. 5.

“ This represents catch-meadow, for a steep declivity, or side of a hill. It is called *catch*, because, when the whole is watered at once, the water floating over the uppermost pitches is caught in the floating-gutters, which distribute the water over the inferior pitches.

“ The lateral horizontal feeding-gutters, which scatter the water over the first and second pitches, are represented as shut by fods or stones, &c. (8); and consequently these first and second pitches appear dry: The whole water is represented as passing down the main-feeder into the lowest floating-gutter, whence it floats the lowest or third pitch; and is received into the drain at the foot of the meadow, to be returned by it into the natural channel.

“ When the whole is to be floated at once, the obstructions (8) are taken from the lateral floating-gutters: obstructions, mean time, are placed in the main-feeder, immediately under the floating-gutters, to force the water into said gutters.

“ N. B. In obstructing the main-feeder, care must be taken not to obstruct it entirely, but to allow always a part of the water it contains to escape in it to the lower pitches; for, supposing the main-feeder to be entirely shut under the feeding-gutter (g 1.); so that the whole water was made to run over the first pitch, from said gutter and the horizontal part of the main-drain, the water
filtrated

filtrated through the grafs of the firft pitch, would be fo very much deprived of its fertilizing qualities, as to be incapable of communicating almoft any perceptible benefit to the pitches lying below. Water fo filtrated, is called technically *ufed water*; and is efteemed next to ufelefs; and for this reafon, the grafs neareft the floating-gutters is moft abundant, and of beft quality, in all kinds of meadow.

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Grafs.

“ The proper breadth of the pitches of catch-meadow, from gutter to gutter, does not feem well determined; they ought, probably, not to be much broader than the diftance from the floating-gutter to the receiving-drain in float-meadow, i. e. from four to five or fix yards.—Catch-meadow is not fo much prized as float-meadow.

“ In the conftruction of the float-meadows, the floating gutters die away to nothing before they meet the main-drain; the water from the end of the gutter finding its way over the intervening fpace, or being affifted in fcattring by fmall ruts marked (r). The receiving-drains fhould, for like reafon, not be commenced till within half a ridge breadth of the main-feeder.”

It is to be obferved, with regard to the laft of thefe modes of flooding, called *catch-meadow*, that although lands thus watered do not become equal to more level grounds fubjected to the fame procefs, or float-meadow, yet that the improvement of them is perhaps greater in proportion to the value of lands in their original ftate; for in this way, lands on the declivity of hills, which once produced next to nothing, are enabled to bear a confiderable crop of valuable grafs. As freams of water are in high countries fre-

Importance
of catch-
meadow.

Culture of frequently found descending from very lofty situations,
Grafts. and as in these cases the expence of forming *catch-meadow* is very trifling, it may be regarded as of the most extensive utility.

Water, how conveyed across roads. In conveying water for the purposes of irrigation from a river to lands at a distance, by means of a canal or open ditch, it is sometimes necessary to cross a road that is situated upon the same level. The mode of accomplishing this object in Lombardy is thus explained by Arthur Young Esq. *: "The contrivances towards Turin for carrying the aqueducts of irrigation across the roads are beautifully executed; for convenience of distribution the water-course is raised three or four feet or more above the general level: these aqueducts are brought to the side of the road, and seemingly finish in a wall, but really sink in a syphon of masonry under the road, and rise on the other side behind another similar wall. Seeing these buttresses of masonry without perceiving at first any water, I wondered for a moment, to what use they could be assigned; but when I mounted the foot-way, this beautiful contrivance was at once apparent."

Encouragement due to irrigation. When we consider the great extent to which irrigation might be carried in many parts of this country, together with the fertility, that is to say, the riches, to be derived from the proper use of so cheap an ingredient as cold water, which is at present allowed to run to waste in such abundance, it is worthy of consideration how far the legislature would not be justified in adopting some public regulation for giving facility to undertakings

undertakings of this sort. The last-quoted author, in travelling through Lombardy, remarks, that “the power of effecting the great works in irrigation, which are visible over this whole country, depends very much on the law, which supposes the right and property of all rivers to be vested in the king; consequently all canals taken from them are bought of him: and this infuses another regulation, which is the power of carrying the water, when bought, at the pleasure of those who buy it, where they think fit. They cannot, however, cut across any man’s ground, without paying him for the land and for the damage; but the law does this by regulations known to every one, and no individual is allowed a negative upon a measure which is for the general good. The purchasers of water from the king are usually considerable land-owners, or communities that have lands wanting water; and it is of no consequence at what distance these lands may be from the river whence the water is taken, as they have a right to conduct it where they choose, provided they do not cut through a garden or pleasure-ground. Nor can they carry the water under that of others, whose canals are already made, as they might, in that case, deprive them of a part of their water; they are obliged to throw aqueducts over such canals. The benefit of water is so great and well understood, that nobody ever thinks of making objections; and, in case their lands are not already watered, it is no small advantage to have a new canal brought through them, as they have the opportunity of buying water of the proprietors. It is sold per hour per week; and even half an hour, and down to a quarter. The common price of an hour per week, for ever, is 1500 liv.”

Culture of
Grass.

Rotation of
Crops.

SECT. V.

ROTATION OF CROPS.

Importance
of a proper
rotation of
crops.

IT is most justly observed by Mr Young* that "there is no circumstance which so strongly distinguishes the knowledge of the present age in the theory and practice of husbandry, in comparison with that of all preceding periods, as this of the right arrangement of the crops cultivated on arable land. Compared with this, all other articles are of very little importance. Unless this part of the farmer's conduct be well understood, the greatest exertion and improvement in other branches of his business lose their effect; and a nation finds the cultivation of its territory producing wealth and prosperity almost exactly in proportion to the intelligence with which its husbandmen observe this leading principle of the art. As the difference between good and bad farmers depends more on this point than on any other, so the difference between well and ill cultivated countries is almost wholly resolvable into the effects derived from the rotation of crops."

The object of the art of agriculture is to make the soil permanently yield the largest possible quantity of valuable produce in the shortest possible period of time. To accomplish this object, however, it is necessary to take

* *Travels*, vol. ii.

take care that in our haste to obtain large quantities of a favourite product, we do not injure the future productive powers of the soil, or kill the goose to obtain immediately its whole golden eggs. As the most valuable crops always do, in some degree, diminish the future fertility of the land, measures must be adopted for restoring that fertility by other crops. It is also necessary to avoid using in repeated succession such crops as are injurious mechanically to the fertility of the soil, by binding it, or rendering it stiff and impervious to the roots of grain or other plants. It is farther requisite, that such a succession of crops be observed as may have a tendency to prevent the growth, or to promote the extirpation, of those natural plants in which the soil delights, but which are of no use to man. The nice point is, to intermix crops, so as to make the greatest profit consistently with keeping the ground in proper order. In that view, the nature of the plants employed in husbandry must be accurately examined.

The difference between culmiferous and leguminous plants, was occasionally mentioned above. With respect to the present subject, a closer inspection is necessary. Culmiferous plants, having small leaves and few in number, depend mostly on the soil for nourishment, and little on the air. During the ripening of the seed, they draw probably their whole nourishment from the soil; as the leaves by this time, being dry and withered, must have lost their power of drawing nourishment from the air. Now, as culmiferous plants are chiefly cultivated for their seed, and are not cut down till the seed be fully ripe, they may be pronounced all of them to be robbers, some more, some less. But such plants, while young, are all leaves; and in that state resemble leguminous plants.

Rotation of leguminous plants. Hence it is, that when cut green
Crops.

as food for cattle, a culmiferous crop is far from being a robber. A hay-crop, accordingly, even where it consists mostly of rye-grass, is not a robber, provided it be cut before the seed is formed; which at any rate it ought to be, if we would have hay in perfection. And the foggage, excluding the frost by covering the ground, keeps the roots warm. A leguminous crop, on the contrary, when cut green for food, must be extremely gentle to the ground. Peas and beans are leguminous plants: but being cultivated for seed, they seem to occupy a middle station: their seed makes them more severe than other leguminous crops cut green; their leaves, which grow till reaping, make them less severe than a culmiferous plant left to ripen.

These plants are distinguished no less remarkably by the following circumstance. All the seeds of a culmiferous plant ripen at the same time. As soon as they begin to form, the plant becomes stationary, the leaves wither, the roots cease to push, and the plant, when cut down, is blanched and sapless. The seeds of a leguminous plant are formed successively: flowers and fruit appear at the same time in different parts of the plant. This plant accordingly is continually growing, and pushing its roots. Hence the value of bean or pease straw above that of wheat or oats: the latter is withered and dry when the crop is cut; the former, green and succulent. The difference, therefore, with respect to the soil, between a culmiferous and leguminous crop, is great. The latter, growing till cut down, keeps the ground in constant motion, and leaves it to the plough loose and mellow. The former gives over growing long before reaping; and the ground, by want
of

of motion, turns compact and hard. Nor is this all : Rotation of Crops.
Dew falling on a culmiferous crop after the ground begins to harden, rests on the surface, and is sucked up by the next sun. Dew that falls on a leguminous crop is shaded from the sun by the broad leaves, and sinks at leisure into the ground. The ground accordingly, after a culmiferous crop, is not only hard, but dry : after a leguminous crop, it is not only loose, but soft and unctuous.

Of all culmiferous plants, wheat is the most severe, by the long time it occupies the ground without admitting a plough. And as the grain is heavier than that of barley or oats, it probably requires more nourishment than either. It is observed above, that as peas and beans draw part of their nourishment from the air, by their green leaves, while allowed to stand, they draw the less from the ground ; and by their constant growing they leave it in good condition for subsequent crops. In both respects they are preferable to any culmiferous crop.

Culmiferous crops, as observed above, are not robbers when cut green : the soil, far from hardening, is kept in constant motion by the pushing of the roots, and is left more tender than if it had been left at rest without any bearing crop.

Bulbous-rooted plants are, above all, successful in dividing and pulverizing the soil. Potato-roots grow six, eight, or ten inches under the surface ; and, by their size and number, they divide and pulverize the soil better than can be done by the plough : consequently, whatever be the natural colour of the soil, it is black when a potato-crop is taken up. The potato, however, with respect to its quality of dividing the soil,

Rotation of Crops. foil, must yield to a carrot or parsnip ; which are large roots, and pierce often to the depth of 18 inches. The turnip, by its tap-root, divides the foil more than can be done by a fibrous-rooted plant ; but as its bulbous root grows mostly above ground, it divides the foil less than the potato, the carrot, or the parsnip. Red clover, in that respect, may be put in the same class with turnip.

General principle. The result of the whole is what follows : Culmiferous plants are robbers ; some more, some less : they at the same time bind the foil ; some more, some less. Leguminous plants in both respects are opposite : if any of them rob the foil, it is in a very slight degree ; and all of them without exception loosen the foil. A culmiferous crop, however, is generally the more profitable : but no foil can long bear the burden of such crops, unless relieved by interjected leguminous crops. These, on the other hand, without a mixture of culmiferous crops, would soon render the foil too loose.

Preparatory crops. As formerly mentioned, some crops are rendered extremely valuable from their tendency to produce another crop of a different, but more valuable, kind on the succeeding year. Thus the land is excellently prepared for producing wheat by means of a crop of drilled beans ; and some lands are still better prepared for the same object by a crop of clover, the wheat to be sown upon the clover ley once ploughed. In like manner, turnips, as formerly noticed, are found to afford the best possible preparation for a crop of barley.

The great error into which our forefathers ran in their agriculture consisted of sowing too frequently in succession that kind of grain of which they wished to possess abundance. It is now found that no greater error

than this could possibly be committed. The more ^{Rotation of Crops.} wheat, for example, that a farmer sows, the more he does not reap. On the contrary, that land which is kept in proper order will yield a greater quantity of grain when sown but once in four years, than it would do with inferior husbandry if sown every third year; and it is certain, that if wheat, oats, or barley, were sown upon the same spot every year, the land in a short time would not yield the feed.

That rotation of crops is undoubtedly the best, which has the most complete tendency to accomplish the great objects of agriculture; that is, to enrich the soil by abundance of manure, to preserve it clear of weeds, and to pulverize it when its mechanical quality is stiff, and to give it density and tenacity where it is too light. To ^{Importance of providing food for cattle.} accomplish these objects, the general rule is, that the soil ought to be employed alternately in rearing grain as food for man, and in rearing food for cattle. The crops which are most valuable as food for cattle, have all a tendency to ameliorate the soil. When they consist of grass, they prepare a turf which, when broken up by the plough, affords the most excellent of all manures, while at the same time, by remaining in the state of pasture, a loose soil speedily acquires firmness and tenacity. When the crops reared to feed cattle consist of roots, such as turnips, or plants, such as cabbages or beans, they afford an excellent opportunity at once for pulverizing and cleaning the soil by repeated hoeings. When these crops consist of pease, beans, sown broadcast, or tares, or cabbages, the close covering which they afford to the soil, smothers all weeds, and leaves the land in a state of increased fertility.

As a general principle, therefore, it is impossible to
urge

Rotation of Crops. urge too strongly upon persons engaged in agriculture, the importance of rearing and providing food for large quantities of cattle: In this way the soil never fails to produce larger quantities of grain than it would otherwise have done; but, at the same time, the whole butcher's meat, cheese, milk, butter, wool, and leather, are so much clear additional produce gained from the land; by means of which the wealth of the country and its power of providing for a numerous population is enormously increased. The necessity of rearing cattle upon a farm, like every general rule, no doubt, admits of exceptions. In the neighbourhood of great cities immense quantities of dung may perhaps be procured, which may supersede the necessity of its being prepared in farm yards. In such a case the whole crop of corn, hay, and roots, may perhaps be safely sold off from the farm every year; but this is only to be allowed, because, in such a situation, the farmer has an opportunity of purchasing, what in the general case, must be provided at home. Upon this subject Mr Young judiciously remarks, * that "that country, that farm, will be most improved and most productive, upon which the greatest quantity of cattle and sheep is kept. This holds good of an acre, a field, a farm, a district, a province, or a kingdom. This point, of such infinite and national importance, depends absolutely on the course of crops. Reiterated and satisfactory experiment has proved, that two crops of white corn ought not to come together. Instances may possibly be quoted to the contrary; but, to reason on particular exceptions, would

ould be endless. If this rule be broken, it is general-
 ly at the expence of cattle and sheep, and of dung; and Rotation of Crops.
 whatever is purchas'd at that expence is purchas'd
 dearly. Out of such a maxim, the right conduct rises
 naturally: it supposes corn and cattle crops alternately;
 part of the arable, therefore, maintains cattle, and part
 yields corn. This will decide the nature of the crop;
~~for cattle and sheep~~ must be supported in winter as
 well as in summer; the crops for each season must,
 therefore, be proportioned to each other, and the ar-
 rangement must be such as preserves the land clean. It
 would be evidently useless to take notice of the variety
 of cases that may admit variations, without militating
 against the leading principles of such a deduction. Land
 may be so rich as to want neither cattle or sheep; it
 may, like some on the Garonne in France, produce
 hemp and wheat for ever; it may be so near a great ci-
 ty, that purchas'd manure may make other courses
 more eligible; certain crops may be in such demand, as
 to make it desirable to cultivate them by way of fal-
 low, though not for cattle or sheep, as cole-seed for oil,
 tobacco, flax, and other articles. Such exceptions,
 which, in the nature of things, must be numerous, are
 in no respect contrary to the leading principles that ought
 to govern throughout this inquiry. For, the winter
 support of cattle and sheep there are turnips, cabbages,
 potatoes, rape, carrots, parsnips, beans, vetches; for
 the summer sustenance, cultivated grasses of all kinds,
 which should necessarily be adapted to the quality of
 soil, and to last in proportion to the poverty of it, and
 to the nature of the grass. Hence then some courses
 arrange themselves that are applicable, perhaps, to all
 the soils of the world.

Rotation of
Crops.

1. Roots, cabbage, or pulse.
2. Corn.
3. Grasses.
4. Corn.

And 1. Roots or cabbage.

2. Corn.
3. Grasses.
4. Pulse or maize, hemp or flax.
5. Corn.

And in these the chief distinction relative to soil will be the number of years in which the grasses are left : these are various in particular cases, but the number is inconsiderable."

Experi-
ments by
Mr Young.

Having thus stated the general principles upon which the rotation of crops ought to proceed, and which the judicious farmer must apply to the circumstances of his own particular case, we proceed to give examples of specific rotations that have been recommended by the practice of successful agriculturists. The last-quoted writer, Arthur Young, Esq. made no less than thirty-six different experiments of a six years rotation, of which he has published the result *. The soil was a sandy loam on a clay marl bottom, very wet naturally, but rendered dry by hollow-drains made some years back. It had been long under grass, and was worth 10s. an acre rent, but had been improved, and let at 20s. ; after which the tenant had brought it down to the value of 15s. an acre, in which state it was when a field was divided in 1787, into thirty-six parts or squares, and the course of experiments begun. We shall

* *Annals of Agriculture*, vol. xxiii.

not here recite the various rotations devised and put in practice on the above occasion, by this ingenious and justly celebrated agriculturist; but shall state for the instruction of the reader the following inferences, drawn by him from the whole course of experiments. In these it will be observed, that all hoed crops are denominated fallow crops, as being substituted for the old ~~and Rice of former~~ fallows. Rotation of Crops.

I. "That potatoes exhaust more than any other fallow crop tried; much more even than barley, and more even than wheat in some courses.

II. "That potatoes will not yield a tolerable crop even on old ley, newly broken up, on such a soil, without the aid of dung; and not a profitable crop even with it.

III. "That barley, beans, and oats, succeed much better than wheat after potatoes.

IV. "That beans are the most valuable fallow crop on new land of this quality.

V. "That the preservation of the fertility of old turf depends greatly on the number of bean crops introduced; the oftener they are planted, the better the succeeding crops of white corn; and that three successive years of beans are attended by an extraordinary produce of wheat.

VI. "That beans and barley alternately, and beans and wheat alternately, are both courses of great produce and profit.

VII. "That the introduction of beans, in bad rotations, tends to remedy the evil of such rotations.

VIII. "That successive crops of white corn are destructive of that fertility which different rotations will preserve in new ground; and that three such will re-

Rotation of ^{Crops.} duce the land to a foul and most unprofitable condition.

IX. "That the two most productive courses are beans and barley alternately, and beans and wheat alternately; the former the most productive, but the latter most profitable from saving of tillage.

X. "That four crops of beans and one of wheat, even with the drawback of one year's cabbage, is a better course of profit; and the land left in such order as to make it perhaps the first.

XI. "That the most unproductive, and in a yet greater degree the most unprofitable courses, are those in which turnips, cabbages, and potatoes, the most often occur.

XII. "That oats are on such new land the best white crop that can be sown, yielding a very extraordinary produce and profit."

Mr Young gives the following opinion upon the whole: "I am inclined to think, that such a course as this would prove the most profitable:—1. Beans; 2. oats; 3. beans; 4. oats; 5. beans; 6. oats; 7. clover; 8. beans; 9. wheat; because the profit of beans in every rotation in which the soil was not exhausted is decisive; because oats, while the old turf is decaying, are far more productive than either barley or wheat; because clover would revive the fertility which beans, in the eighth year, would not lessen, and wheat after those two successive ameliorating crops would not fail of yielding a handsome produce. I recommend such a rotation, however, for new land only."

Alternate
corn and
grass.

'There is an alternate husbandry of grass and corn which possesses great advantages, and is very profitable, as, by laying most kinds of land to grass, and by pasturing

ing them, especially with sheep, they are prepared in the best manner for corn. This kind of husbandry is adopted in many parts both in Scotland and England. The Rev. Arthur Young recommends the following rotations to be adopted for it.

On Soils inclinable to moisture or of good Fertility.

On dry Land.

2. Turnips.

3. Barley.

4. Clover or winter tares.

5. Wheat.

6. Turnips.

7. Barley.

8. Grass for three or four years.

1. White pease and turnips.

2. Barley.

3. Clover.

4. Wheat.

5. Turnips.

6. Barley.

7. Grass for three years.

“Loam in grass break up with, 1. oats; 2. turnips; 3. barley; 4. grass; 5. grass; 6. grass: or, 1. turnips; 2. barley; 3. clover; 4. wheat; 5. turnips; 6. barley; 7. grass; 8. grass; 9. grass; 10. grass. —Wet loams break up with, 1. oats; 2. beans; 3. wheat; 4. fallow and grass; 5. grass; 6. grass; 7. grass; 8. grass.

“Such husbandry must keep land in a constant state of fertility.”

The same author observes, that “this alternate husbandry appears to be well understood in Northumberland. By means of three years grass, depastured with sheep, the land will grow good crops of oats, which they could never get it to do under their old system; soil sandy and dry light loams. Various systems have been tried in Northumberland, particularly the boasted courses of, 1. turnips; 2. barley; 3. clover; 4. wheat;

Rotation of till the crops have evidently declined, particularly the
Crops.

turnips and clover; and the only means of restoring such lands has been in the system of three years arable and three years grafs, depastured by sheep: by this mode nature has time to prepare a sufficient lea-clod, which being turned up for the turnip fallow, will insure a vigorous crop of turnips; as it is well known that they always flourish upon fresh land, ~~or, for the turnip, &c.~~ the remains of a lea-clod to vegetate in. The portion that is kept in grafs for three years breeds and fattens such a number of sheep as leaves a considerable profit, probably equal to, if not more than, the arable crops, the yearly profits of a sheep being estimated at not less than 2cs. or 3cs. six or eight of which an acre of clover will fatten, and an acre of turnips about double the number." This is to the credit of the Northumberland drill system, or the soil must be very extraordinary. "By this system (the author goes on) are obtained the principal advantages of folding, without any of its inconveniences."

In consequence of the premiums offered by the Board of Agriculture for essays upon the best mode of breaking up pasture lands, and of restoring them to grafs, without injury, a great variety of excellent rotations were suggested. The Rev. Mr Arthur Young, above quoted, proposes for clay soils the following rotations: "With paring and burning, and for four years tillage:—1. Pare and burn for cole or cabbage, to be fed on the land with sheep; 2. beans; 3. wheat; 4. fallow and grafs.

Rev. Mr
Young on
rotations.

"For six years tillage:—1. Cole; 2. beans; 3. wheat; 4. beans; 5. wheat; 6. fallow and grafs. The beans ought

It to be dibbled one row on every other furrow, and ^{Rotation of} thoroughly horse and hand-hoed. _{Crops.}

Without paring and burning.—Break up the old grafs by one earth, and dibble in, 1. beans; 2. oats; 3. clover; 4. beans; 5. wheat; 6. fallow and grafs.

“If as much wheat as possible be in contemplation :

1. Beans.

~~2. Wheat.~~

3. Beans.

4. Wheat.

5. Beans.

5. Fallow and grafs.

6. Wheat.

7. Fallow and grafs.

On *loam* the same writer recommends the following among other rotations:—“1. Oats dibbled; 2. turnips; 3. barley; 4. clover; 5. wheat; 6. turnips; 7. barley and grafs; or either of the two following :

1. Pare and burn for turnips. 1 Pare and burn for turnips.

2. Turnips.

2. Barley.

3. Barley.

3. Clover.

4. Clover.

4. Wheat.

5. Wheat.

5. Turnips.

6. Turnips.

6. Turnips.

7. Barley and grafs.

7. Barley and grafs.

“In proportion to the dryness and lightness of the loam white pease are applicable:—1. Pease dibbled; 2. wheat; 3. turnips; 4. barley; 5. clover; 6. wheat; 7. turnips; 8. barley and grafs.

“Potatoes are admissible; but as they exhaust, they are to be guarded by a course which afterwards replenishes:—1. Potatoes; 2. barley; 3. clover; 4. wheat; 5. turnips; 6. turnips; 7. barley and grafs.”

For a sandy soil the same writer recommends, in general, the following rotations: “1. Turnips; 2. barley;

Rotation of Crops. 3. grafs; 4. grafs; 5. grafs; 6. white peafe; 7. wh. r.,
 { barley, or oats: or, 1. turnips; 2. barley; 3, 4, 5, and
 6, grafs; 7. peafe; 8. turnips; 9. barley."

On a chalky foil, called in England *downs*, *wolds*, &c. he recommends, "1. Pare and burn for turnips; 2. turnips; 3. barley; 4. clover; 5. wheat; 6. turnips; 7. turnips; 8. barley; 9. sainfoin for not lefs than ten years."

Upon peat he propofes, 1. Turnip, cabbage, or cole; 2. oats; 3. turnip, cabbage, or cole; 4. oats and grafs: or continued to 8 years, by 5. clover; 6. wheat; 7. turnips, cabbage, or cole; 8. oats and grafs.

"Potatoes are admiſſible; but, as they exhaust, are to be guarded by, 1. Pare and burn for potatoes; 2. oats; 3. turnip-cabbage, or cole; 4. ditto; 5. oats and grafs."

Rotation by Mr Cloſe. The Rev. H. J. Cloſe, a zealous adherent of the drill husbandry, in the eſſay already quoted, gives the following view of a courſe of crops adapted to various foils for any number of years.

	Turnips, Cabbage Ditto.	Oats Ditto.	Beans and Clover.	Wheat Ditto.	Turnips or Cabbages Ditto.	Oats Barley.	Beans and Vetches. Beans. Pease.	Wheat. Ditto.
<i>Clay.</i>								
<i>Clayey Loam</i>	Turnips & Potatoes. Beans	Barley Ditto.	Clover. Ditto.	Ditto.	Beans. Ad infinitum.	Ditto.		
<i>Rich Loam, or Sandy Loams.</i>	Turnips. Turnips	Ditto. Ditto.	Pease Clover. Ditto.	Ditto. Ditto.	Potatoes. Ditto.	Barley. Ditto.	Pease. Ditto.	Wheat. Ditto.
<i>Peat Earth.</i>	Ditto.	Ditto.	Ditto.	Ditto.	Potatoes.	Ditto.	Ditto.	Ditto.
<i>Chalky Substratum*.</i>	Ditto.	Ditto.	Ditto.	Ditto.	Potatoes. Clover & Rye-grass.	Barley. Pease.	Pease. Wheat or Rye.	Wheat.
<i>Gravels.</i>								
<i>Light Lands.</i>								

* On this

hundred should be sown with

eight

"This course of husbandry on the recommended condition that the crops are allowed and kept perfectly clean; and the turnips, pease, and ears, be put in double rows on three-foot ridges, and the cabbages in single rows three-foot ridges."

Rotation of Crops.

Rotation of Crops. In Scotland, in high exposed situations upon generally
 ly soils, accounted unfit for wheat on account of the climate, the following rotation upon cattle farms is understood to be successful : 1. Turnips eaten by cattle and sheep in a close for making dung ; 2. barley or oats ; 3. clover fed down early with sheep and lambs, afterwards cut for hay in the end of summer ; 4. oats ; 5. turnips, &c.

Scottish rotations.

In the neighbourhood of towns, where manure can be purchased, the above rotations will not be considered as applicable, as one great object they have in view is the preparation of dung. Where this is not a part of the farmer's employment, in consequence of the opportunity of purchase, turnips, cabbages, &c. will naturally be neglected, and he will endeavour to produce either human food or hay, &c. for the great numbers of horses that are now kept in cities as objects of luxury. Accordingly, in the neighbourhood of Edinburgh, the following is not an unfrequent rotation : 1. Fallow without dung, or potatoes with dung, where the ground is light or dry ; 2. wheat ; 3. beans dunged, drilled on light land, broadcast on the heavy ; 4. wheat ; 5. barley ; 6. and 7. clover and rye-grass hay ; 8. oats ; 9. fallow, or potatoes with dung.

In a tour through Suffex, the Rev. Arthur Young mentions*, with just approbation, the following rotation as used in a part of that county : " 1. Turnips ; 2. barley ; 3. clover ; 4. wheat ; 5. pease. If their land be in good order, it has only a single ploughing for wheat, but in wet summers, more ; the land being subject to couch-grass."

It will be observed, that in the examples hitherto given of rotations, we have endeavoured, as far as possible,

* *Annals of Agriculture*, vol. xxvii.

to exclude those in which fallow is used, because ^{Rotation of Crops.} we are satisfied, that agriculture is only brought to its highest possible perfection in proportion to the degree in which fallows are exchanged for drilled green crops, which clean the land; while, at the same time, by affording subsistence for cattle, they bestow the means of enriching it. As the stiff clay soil, however, which so ^{Fallow requisite on clay soils.} ~~is not abundant~~ in our country, renders the drill system in many situations extremely difficult, and the consumption of turnips upon the field altogether impracticable, it is not wonderful that fallows are still used extensively, and even considered as necessary. Neither do we think, that a system should rashly be relinquished which has been approved of for ages, and which, in the hands of skilful and industrious men, is attended with no small profit. We shall, therefore, state an example or two of rotations with fallow upon a clay soil. We shall begin with the example of a farmer who has 90 acres of a clay soil. Of these, six acres are to be enclosed for a kitchen garden, in which there must be annually a crop of red clover, for summer food to the working cattle. As there are annually 12 acres in hay, and 12 in pasture, a single plough with good cattle will be sufficient to command the remaining 60 acres.

Rotations in a clay Soil.

Inclot.	1795.	1796.	1797.	1798.	1799.	1800.
1.	Fallow.	Wheat.	Pease.	Barley.	Hay.	Oats.
2.	Wheat.	Pease.	Barley.	Hay.	Oats.	Fallow.
3.	Pease.	Barley.	Hay.	Oats.	Fallow.	Wheat.
4.	Barley.	Hay.	Oats.	Fallow.	Wheat.	Pease.
5.	Hay.	Oats.	Fallow.	Wheat.	Pease.	Barley.
6.	Oats.	Fallow.	Wheat.	Pease.	Barley.	Hay.
7.	Pasture.	Pasture.	Pasture.	Pasture.	Pasture.	Pasture.

When

Rotation of When the rotation is completed, the seventh inclo-
 sure, having been six years in pasture, is ready to be taken up for a rotation of crops which begins with oats in the year 1801, and proceeds as in the sixth inclosure. In the same year 1801 the fifth inclosure is made pasture, for which it is prepared by sowing pasture-grass seeds with the barley of the year 1800. And in this manner may the rotation be carried on ~~without end~~. Here the labour is equally distributed; and there is no hurry nor confusion. But the chief property of this rotation is, that two culmiferous or white-corn crops are never found together; by a due mixture of crops, the soil is preserved in good heart without any adventitious manure. At the same time, the land is always producing plentiful crops: neither hay nor pasture get time to degenerate. The whole dung is laid upon the fallow.

Every farm that takes a grass crop into the rotation must be inclosed, which is peculiarly necessary in a clay soil, as nothing is more hurtful to clay than poaching.

Marsh-land rotation. In addition to these, we shall here state, from the Agricultural Survey of Yorkshire, an example of a rotation used in that county upon a marsh-land farm consisting of 432 acres of arable land, in which a very great number of hands and horses appear to have been employed, but in which very valuable products are reared. "The soil, where the principal part of the potatoes are grown, is a good warp; the other part on which potatoes are also cultivated, a mixture of warp and sand: the remainder of the land, clay, with a small portion of warp, but too strong to grow potatoes, except about 70 acres, which is tolerable good potato-land."

land, but at too great a distance from the river. ^{Rotation of Crops} ~~Grafs~~ land only sufficient to keep two milch cows, and horses necessary for working the farm: 69 acres of the best warp land divided into three equal parts: 1. fallow, with from 16 to 20 loads of manure per acre; set it with potatoes; after sow wheat; and then fallow again: three acres of the same kind of land that is liable to be damaged by sparrows when sown with corn, is set with potatoes every year with about 10 loads of manure per acre each year: 84 acres of the lighter land is divided in the same manner, one-third fallow, with 10 loads of manure per acre; set potatoes and then sow wheat, and fallow again: 42 acres of land, lately an old pasture, divided into three parts; one-third flax, then sown with rape, and after they come off, plough and harrow the land three or four times, and lay upon it about 20 loads of manure per acre, which will make it in great condition; after which set potatoes, then sow flax again, and rape after: 150 acres divided into three parts; 1. fallow; 2. wheat; 3. beans, drilled at 9 inches distance, hand-hoed twice at 6s. per acre; fallow again, &c.: 80 acres of land that was lately in old grafs divided into four parts; fallow, wheat, beans drilled, and oats; then fallow again, &c. The remaining four acres thrown to any of the crops that are likely to fail. Rent 25s. per acre; assessments 5s. per acre.

“*Distribution*”

Rotation of
Crops.*" Distribution of Crops for 1795.*

		Acres.	Average Produce of an Acre.
Wheat,	- -	121	from 3 to 5 quarters.
Beans,	- -	70	from 3 to 6 quarters.
Oats,	- -	20	from 6 to 10 quarters
Flax,	- -	14	from 45 to 55 stones.
Rape,	- -	14	from 5 to 5 quarters.
Potatoes,	- -	68	from 50 to 100 sacks.
Fallow,	- -	121	
To be thrown where a crop is likely to fail,			4

432

" Servants, Horses, and Cows kept upon the Farm.

4 House servants,
16 Labourers,
26 Horses,
2 Milch cows.

"The above is an account of a farm belonging to one of the best managers of marsh-land. We must observe, he fallows his land very often; yet he is well paid by his superior crops. The last year (1795) he had 100 sacks per acre off most of his potato-land; and sold them from 8s. to 12s. per sack of 14 pecks. All their corn is sold by the quarter of eight Winchester bushels, though I believe their measure rather overruns."

SECT. VI.

OF REAPING CORN AND HAY CROPS, AND STORING THEM UP FOR USE.

CULMIFEROUS plants are ripe when the stem is to- Of ripeness.
tally white : they are not fully ripe if any green streaks remain. Some farmers are of opinion, that wheat ought to be cut before it is fully ripe. Their reasons are, first, that ripe wheat is apt to shake ; and next, that the flour is not so good. With respect to the last, it is contrary to nature, that any seed can be better in an unripe state than when brought to perfection ; nor will it be found so upon trial. With respect to the first, wheat, at the point of perfection, is not more apt to shake than for some days before : the husk begins not to open till after the seed is fully ripe ; and then the suffering the crop to stand becomes ticklish ; after the minute of ripening, it should be cut down in an instant, it possible.

This leads to the hands that are commonly engaged Of reapers.
to cut down corn. In Scotland, the universal practice was, to provide a number of hands, in proportion to the extent of the crop, without regard to the time of ripening. By this method, the reapers were often idle for want of work ; and what is much worse, they had often more work than they could overtake, and ripe fields were laid open to shaking winds. The Lothians have long enjoyed weekly markets for reapers where a farmer

Reaping
and Storing
up Corn
and Hay

farmer can provide himself with the number he wants ; and this practice is creeping into neighbouring shires. Where there is no opportunity of such markets, neighbouring farmers ought to agree in borrowing and lending their reapers.

One should imagine, that a caution against cutting corn when wet is unnecessary ; yet from the impatience of farmers to prevent shaking, no caveat is more so. Why do they not consider, that corn standing dries in half a day ; when, in a close sheaf, the weather must be favourable if it dry in a month ? in moist weather it will never dry.

Manner of
cutting.

With respect to the manner of cutting, we must premise, that barley is of all the most difficult grain to be dried for keeping. Having no husk, rain has an easy access ; and it has a tendency to malten when wet. Where the ground is properly smoothed by rolling, it seems best to cut it down with the scythe. This manner being more expeditious than the sickle, removes it sooner from danger of wind ; and gives a third more straw, which is a capital article for dung, where a farm is at a distance from other manure. We except only corn that has lodged ; for there the sickle is more convenient than the scythe. As it ought to be dry when cut, bind it up directly ; if allowed to lie any time in the swath, it is apt to be discoloured.—Barley sown with grass-seeds, red clover especially, requires a different management. Where the grass is cut along with it, the difficulty is great of getting it so dry as to be ventured in a stack. The best way is, to cut the barley with a sickle above the clover, so as that nothing but clean barley is bound up. Cut with a scythe the stubble and grass : they make excellent winter food. The same method

method is applicable to oats; with this only difference, that when the field is exposed to the south-west wind, it is less necessary to bind immediately after mowing. As wheat commonly grows higher than any other grain, it is difficult to manage it with the scythe; for which reason the sickle is preferred in England. Pease and beans grow so irregularly, as to make the sickle necessary.

Reaping
and Storing
up Corn
and Hay.

“ Some time ago, an experiment was made in East Lothian to ascertain the difference betwixt high and low cutting. Four ridges of wheat were cut, which were of equal length and breadth, and apparently the same in quality. Two of them were cut close by the ground, and the other two considerably higher, though not so high as in many places of the west riding. The measure of each two ridges was a very trifle more than a quarter of a Scotch acre, which is one-fifth more than the English statute measure. The low cutting was done by eight reapers in an hour and twenty-four minutes; the high cutting in forty-eight minutes by the same hands. The wheat was thrashed separately, and the corn and straw measured and carefully weighed.

Result. Eight reapers, 1 hour 24 minutes, at 1s. 6d. per day (being the rate of wages that week), and 6d. for victuals, is 2s. •

per day, - - L.— 2 4

'The high cutting, by the same hands, 48

minutes, at ditto or 4s. per Scots acre, — 1 4

Difference of expence, 1 1 0

Reaping and Storing up Corn and Hay.	1½ Peck more wheat upon the two ridges, low cut, than upon those cut high, at 1s. 4d. per peck, is	-	-	—	1	8
	14 Stone (of 22 English pounds) more straw, at 2d. per stone,	-	-	—	2	4

From which deduct the difference of ex-
pence in cutting, - -

— 3 0

“Benefit derived from cutting low being 3s. the
quarter of an acre, or 12s. per acre.”

In the Transactions of the Patriotic Society of Milan,
an attempt is made to recommend the use of the scythe
in reaping grain, to the entire exclusion of the sickle.
It is observed, that “it has been a question in agricul-
ture, whether scythes or sickles were most advantage-
ously used for reaping corn. All persons agree, that
much more work, and with less labour, may be done
with the scythe than with the sickle; but some say,
that the saving of time and labour is not sufficient
to compensate the disadvantages attending that me-
thod.

“It is said, that the scythe shakes the ear, so that
many of the grains are lost; that it lets the corn fall,
after cutting it, in a confused and scattered state, so that
either much of it is lost, or a great deal of time is con-
sumed in gathering it together; that it can only be made
use of in land which is very even and free from stones;
that it does not leave sufficient length of stubble in
the ground to lay the corn on when cut; that it mixes
bad weeds with the corn, the seeds of which are sown
the

the next year ; and lastly, that the use of the scythe is prejudicial to the health of the reaper.

Reaping
and Storing
up Corn
and Hay.

“ These objections, however, are either of no weight, or they are made by those who are not acquainted with the good scythes which have been adapted to this purpose, and with the proper manner of using them. With a good scythe, properly managed, the corn, after being cut, remains at first upright, and then falls very gently upon the rake fixed to the scythe, without any shake or jolt ; or at least with less than that it receives when reaped with a sickle. With respect to the loss of grain, that proceeds chiefly from the corn being too dry ; consequently it should be reaped only upon proper days and proper times of the day, which is much more easily done with the scythe than with the sickle, because the work is so much shorter ; the stalks kept together by the rake may be laid upon the ground, or rather against the corn not yet cut, in so regular and collected a state, that those who gather and tie the sheaves, whether they are women or children, have nothing but their own negligence to accuse, if any thing is left behind. . When land is properly ploughed and harrowed, it is sufficiently even ; and in such as is stony, the only precaution necessary is to keep the scythe a little higher in using it, that it may not strike against the stones. If the stubble left in the ground be short, the straw which is cut off will be the longer ; and the latter is certainly of more value than the former, which only serves to incommode the cattle which afterwards go to feed in the field. If the posture and manner of using the sickle be compared with the management of the scythe, it must very clearly appear, that the latter is attended with less inconvenience and

Reaping
and Storing
up Corn
and Hay.

Posture in
mowing
corn.

less danger. It is indeed true, that the workmen who use the scythe are sometimes afflicted with disorders in the kidneys, as Duhamel observes; but that inconvenience arises from their not keeping themselves in a proper posture.

“It should, however, be observed, that, in mowing grass, the feet are kept always parallel to each other; whereas, in reaping corn, they should be kept upon a line, one behind the other, thrusting the right foot forward, and drawing the left towards it. This is necessary; because, when grass is mowed, it is left to fall just where it is cut; but, when corn is cut, it is to be carried, and laid in a proper manner against that which is not yet cut, and which is at the left hand of the reaper; and if the feet were kept parallel to each other, the reaper would be obliged to extend and turn his body in a very inconvenient manner.”

This Society, to encourage the use of scythes, has published different figures of cradle-scythes, which contain nothing very particular. Upon the whole, the use the scythe seems to be gaining ground, in consequence of the high price of labour, though it ought undoubtedly to be made use of under the limitations which we have already stated.

Short
French
scythe.

In some parts of France they use, with advantage, a scythe with a short handle, of a light construction, which is held in one hand only, while the other is employed in collecting the grain. Mr Young mentions it in his travels with approbation*. “The short scythe, which they use through this province (Artois) and all over Flanders,

* Vol. ii.

Flanders, is one of the most useful implements that can be seen; they call it the *pique*. A man cuts an arpent a day in general with it, and sometimes more; he cuts and rolls into bottles an arpent of vetches (called here, mixed with oats, *dravin*); and he cuts an arpent of any sort of white corn, others following to bind with straw bands made at home. This is a most economical system. The short handle of the *pique* is made to rest against the elbow; he holds it with the right hand only, or rather hand and arm; and in his left he has a stick, with a hook at the end of it, with which he draws or holds the corn in the right position to receive the stroke. They use scythes and cradles also for some works.

Reaping
and Storing
up Corn
and Hay.

“*St Omer*.—That the *pique* is much easier to work than a scythe, appears from women and even girls cutting stout crops of tares with it.”

The best way for drying pease, is to keep separate the handfuls that are cut; though in this way they wet easily, they dry as soon. In the common way of heaping pease together for composing a sheaf, they wet as easily, and dry not near so soon. With respect to beans, the top of the handful last cut ought to be laid on the bottom of the former; which gives ready access to the wind. By this method pease and beans are ready for the stack in half the ordinary time.

Drying of
peas.

A sheaf commonly is made as large as can be contained in two lengths of the corn made into a rope. To save frequent tying, the binder presses it down with his knee, and binds it so hard as totally to exclude the air. If there be any moisture in the crop, which seldom fails, a process of fermentation and putrefaction commences in the sheaf; which is perfected in the stack, to the

Size of
sheaves.

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destruction both of corn and straw. How stupid is it, to make the size of a sheaf depend on the height of the plants! By that rule, a wheat sheaf is commonly so weighty, as to be unmanageable by ordinary arms: it requires an effort to move it that frequently bursts the knot, and occasions loss of grain, beside the trouble of a second tying. Sheaves ought never to be larger than can be contained in one length of the plant, cut close to the ground, without admitting any exception, if the plants be above 18 inches high. The binder's arm can then compass the sheaf sufficiently without need of his knee. The additional hands that this way of binding may require, are not to be regarded compared with the advantage of drying soon. Corn thus managed may be ready for the stack in a week; it seldom in the ordinary way requires less than a fortnight, and frequently longer. Of a small sheaf, compressed by the arm only, the air pervades every part; nor is it so apt to be unloosed as a large sheaf, however firmly bound. We omit the gathering of sheaves into shocks, because the common method is good, which is to place the shocks directed to the south-west, in order to resist the force of the wind. Five sheaves on each side make a sufficient stay; and a greater number cannot be covered with two head-sheaves.

Carrying off
the victual.

Every article is of importance that hastens the operation in a country, like Scotland, subject to unequal harvest weather; for which reason, the most expeditious method should be chosen for carrying corn from the field to the stack-yard. Our carriages are generally too small or too large. A sledge is a very awkward machine: many hands are required, and little progress made. Waggon and large carts are little less dilatory,

as they must stand in the yard till unloaded sheaf by sheaf. The best way is, to use long carts moveable upon the axle, so as at once to throw the whole load on the ground; which is forked up to the stack by a hand appointed for that purpose. By this method, two carts will do the work of four or five. Reaping
and Storing
up Corn
and Hay.

Building round stacks in the yard is undoubtedly preferable to housing corn. There it is shut up from the air; and it must be exceeding dry, if it contract not a mustiness, which is the first step to putrefaction. Add to this, that in the yard, a stack is preserved from rats and mice, by being set on a pedestal: whereas no method has hitherto been invented for preserving corn in a house from such destructive vermine. The proper manner of building, is to make every sheaf incline downward from its top to its bottom. Where the sheaves are laid horizontally, the stack will take in rain both above and below. The best form of a stack is that of a cone placed on a cylinder; and the top of the cone should be formed with three sheaves drawn to a point. If the upper part of the cylinder be a little wider than the under, so much the better. Of stack-
ing.

The delaying to cover a stack for two or three weeks, though common, is, however, exceeding absurd; for if much rain fall in the interim, it is beyond the power of wind to dry the stack. Vegetation begun in the external parts, shuts out the air from the internal; and to prevent a total putrefaction, the stack must be thrown down and exposed to the air every sheaf. In order to have a stack covered the moment it is finished, straw and ropes ought to be ready; and the covering ought to be so thick as to be proof against rain. Covering
the stacks.

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and Storing
up Corn
and Hay.

Scotland is subject not only to floods of rain, but to high winds. Good covering guards against the former, and ropes artfully applied guard against the latter. The following is a good mode. Take a hay-rope well twisted, and surround the stack with it, two feet or so below the top. Surround the stack with another such rope immediately below the easing. Connect these two with ropes in an up-and-down position, distant from each other at the easing above five or six feet. Then surround the stack with other circular ropes parallel to the two first mentioned, giving them a twist round every one of those that lie up and down, by which the whole will be connected together in a sort of net-work. What remains is, to finish the two feet at the top of the stack. Let it be covered with bunches of straw laid regularly up and down; the under part to be put under the circular rope first mentioned, which will keep it fast, and the upper part be bound by a small rope artfully twisted, commonly called *the crown of the stack*. This method is preferable to the common way of laying long ropes over the top of the stack, and tying them to the belting-ropes, which flattens the top, and makes it take in rain. A stack covered in the way here described, will stand two years secured both against wind and rain; a notable advantage in this variable climate.

Hay-making.

The great aim in making hay is, to preserve as much of the sap as possible. All agree in this; and yet differ widely in the means of making that aim effectual. To describe all the different means would be equally tedious and unprofitable. We shall confine ourselves to a very few of these. A crop of ryegrass and yellow clover ought to be spread as cut. A day

day or two after, when the dew is evaporated, rake it into a number of parallel rows along the field, termed *wind-rows*, for the convenience of putting it up into small cocks. After turning the rows once and again, make small cocks weighing a stone or two. At the distance of two days or so, put two cocks into one, observing always to mix the tops and bottoms together, and to take a new place for each cock, that the least damage possible may be done to the grass. Proceed in putting two cocks into one, till sufficiently dry for tramp-ricks of 100 stone each. The easiest way of erecting tramp-ricks, is to found a rick in the middle of the row of cocks that are to compose it. The cocks may be carried to the rick by two persons joining arms together. When all the cocks are thus carried to the rick within the distance of 40 yards or so, the rest of the cocks will be more expeditiously carried to the rick, by a rope wound about them and dragged by a horse. Two ropes are sufficient to secure the ricks from wind the short time they are to stand in the field. In the year 1775, 10,000 stone were put into tramp-ricks the fourth day after cutting. In a country so wet as many parts of Scotland are, expedition is of mighty consequence in the drying both of hay and corn. With respect to hay intended for horned cattle, it is by the generality held an improvement, that it be heated a little in the stack; but some violently suspect this doctrine to have been invented for excusing indolent management. An ox, it is true, will eat such hay; but it is usually found that he prefers sweet hay; and it cannot well be doubted, but that such hay is the most salutary and the most nourishing.

Reaping
and Storing
up Corn
and Hay!

The

Reaping
and Storing
up Corn
and Hay.

Hay of red
clover.

The making hay, consisting chiefly of red clover, requires more care. The season of cutting is the last week of June, when it is in full bloom; earlier it may be cut, but never later. To cut it later would indeed produce a weightier crop; but a late first cutting makes the second also late, perhaps too late for drying. At the same time, the want of weight in an early first cutting, is amply compensated by the weight of the second.

When the season is too variable for making hay of the second growth, mix straw with that growth, which will be a substantial food for cattle during winter. This is commonly done by laying strata of the straw and clover alternately in the stack. But by this method, the strata of clover, if they do not heat, turn mouldy at least, and unpalatable. The better way is, to mix them carefully with the hand before they be put into the stack. The dry straw imbibes moisture from the clover and prevents heating.

Dr Anderson's method.

But the best method of hay-making seems to be that recommended by Dr Anderson *. “Instead (says he), of allowing the hay to lie, as usual in most places, for some days in the swath after it is cut, and afterwards, alternately putting it up into cocks and spreading it out, and tedding it in the sun, which tends greatly to bleach the hay, exhales its natural juices, and subjects it very much to the danger of getting rain, and thus runs a great risk of being good for little, I make it a general rule, if possible, never to cut hay but when the grass is quite dry; and then make the gatherers

* *Essays on Agriculture*, vol. i. p. 186.

gatherers follow close upon the cutters, putting it up immediately into small cocks about three feet high each when new put up, and of as small a diameter as they can be made to stand with ; always giving each of them a slight kind of thatching, by drawing a few handfuls of the hay from the bottom of the cock all around, and laying it lightly upon the top with one of the ends hanging downwards. This is done with the utmost ease and expedition ; and when it is once in that state, I consider my hay as in a great measure out of danger : for unless a violent wind should arise immediately after the cocks are put up, so as to overturn them, nothing else can hurt the hay ; as I have often experienced, that no rain, however violent, ever penetrates into these cocks but for a very little way. And, if they are dry put up, they never fit together so closely as to heat ; although they acquire, in a day or two, such a degree of firmness, as to be in no danger of being overturned by wind after that time, unless it blows a hurricane.

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“ In these cocks I allow the hay to remain, until, upon inspection, I judge that it will keep in pretty large tramp-cocks (which is usually in one or two weeks, according as the weather is more or less favourable), when two men, each with a long pronged pitch-fork, lift up one of these small cocks between them with the greatest ease, and carry them one after another to the place where the tramp-cock is to be built * : and in this manner they proceed over the field till the whole is finished.

“ The

* If the hay is to be carried to any considerable distance, this part of the

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Advanta-
ges of this
method.

"The advantages that attend this method of making hay, are, that it greatly abridges the labour; as it does not require above the one-half of the work that is necessary in the old method of turning and tedding it: That it allows the hay to continue almost as green as when it is cut, and preserves its natural juices in the greatest perfection; for, unless it be the little that is exposed to the sun and air upon the surface of the cocks, which is no more bleached than every straw of hay saved in the ordinary way, the whole is dried in the most slow and equal manner that could be desired; and, lastly, That it is thus in a great measure secured from almost the possibility of being damaged by rain. This last circumstance deserves to be much more attended to by the farmer than it usually is at present; as I have seen few who are sufficiently aware of the loss that the quality of their hay sustains by receiving a slight shower after it is cut, and before it is gathered; the generality of farmers seeming to be very well satisfied if they get in their hay without being absolutely rotted, never paying the least attention to its having been several times wetted while the hay was making. But if these gentlemen will take the trouble at any time to compare any parcel of hay that has been made perfectly dry, with another parcel from the same field that has received a shower while in the swathe, or even

the labour may be greatly abridged, by causing the carriers take two long sticks of a sufficient strength, and having laid them down by the small cocks parallel to one another, at the distance of one and a half, or two feet asunder, let them lift three or four cocks, one after another and place them carefully above the sticks, and then carry them altogether, as if upon a hand-barrow, to the place where the large rick is to be built.

a copious dew, they will soon be sensible of a very manifest difference between them; nor will their horses or cattle ever commit a mistake in choosing between the two.

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and Hay.

“ Let it be particularly remarked, that in this manner of making hay, great care must be taken that it be dry when first put into the cocks; for, if it is in the least degree wet at that time, it will turn instantly mouldy, and sit together so as to become totally imperious to the air, and will never afterwards become dry till it is spread out to the sun. For this reason, if at any time during a course of good settled weather you should begin to cut in the morning before the dew is off the grass, keep back the gatherers till the dew is evaporated; allowing that which was first cut to lie till it is dry before it is cocked. In this case, you will almost always find that the uncut grass will dry sooner than that which has been cut when wet; and, therefore, the gatherers may always begin to put up that which is fresh cut before the other; which will usually require two or three hours to dry after the new cut hay may be cocked. And if, at any time, in case of necessity, you should be obliged to cut your hay before it is dry, the same rule must be observed, always to allow it to remain in the swathe till it is quite dry: but, as there is always a great risk of being long in getting it up, and as it never in this case *wins* * so kindly as if it had been dry cut, the farmer ought to endeavour, if possible, in all cases, to cut his hay only when dry; even if

Particular
caution re-
quisite in
this me-
thod.

* By *winning* hay, is meant the operation by which it is brought from the succulent state of grass to that of a dry fodder.

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if it should cost him some additional expence to the cutters, by keeping them employed at any other work, or even allowing them to remain idle if the weather should be variable or rainy.

“ But if there is a great proportion of clover, and the weather should chance to be close and calm at the time, it may, on some occasions, be necessary to open up these cocks a little, to admit some fresh air into them; in which case, after they have stood a day or two, it may be of great use to turn these cocks and open them up a little, which ought to be done in the driest time of the day; the operator taking that part of each cock which was the top, and with it forming the base of a new one; so that the part which was most exposed to the air becomes excluded from it, and that which was undermost comes to be placed upon the top, so as to make it all dry as equally as possible.

“ If the hay has not been damp when it was first put up, the cock may be immediately finished out at once; but if it is at all wet, it will be of great use to turn over only a little of the top of the cock at first, and leaving it in that state to dry a little, proceed to another, and a third, and fourth, &c. treating each in the same way; going on in that manner till you find that the inside of the first opened cock is sufficiently dried, when it will be proper to return to it, turning over a little more of it till you come to what is still damp, when you leave it and proceed to another, and so on round the whole; always returning afresh till the cocks are entirely finished. This is the best way of saving your hay, if you have been under the necessity of cutting it while damp; but it is always best to guard against this inconvenience, if possible.”

We

We learn from the Annals of Agriculture*, that, in consequence of the above suggestion by Dr Anderson, the mode of making hay here recommended, was tried, with success, by David Barclay, Esq. "I hired three mowers at a guinea a week, with beer; and agreed with them to mow, as also to do any other kind of work, from five in the morning until eight in the evening; such as trenching ground, clipping hedges, turning dunghills, &c. but not to mow until the grass was perfectly free from moisture, which was generally about nine o'clock in the morning: when they began, and after they had cut about half an acre, it appeared to be quite dry; three men were sent to put it into cocks about three feet high; and they drew some of the longest of the grass to lay upon the cock, by way of thatch, hanging downwards. When they had proceeded thus far on the first day, a small shower of rain fell, and the mowers returned to their trenching which they were at in the morning; at four o'clock in the afternoon, the grass being dry, they commenced cutting again till night, when the whole was left in cock; next morning about five o'clock a violent shower of rain fell, when my grass was secured, whilst that of my neighbours, which was tedded out, was thoroughly drenched: the afternoon was fair and windy, and all the cocks were opened, and made up again on fresh ground; and so I proceeded cutting, cocking, and opening the cocks, when the weather was quite fair; but, when the weather was doubtful, air was let into the cocks, by two men with pitching forks, raising them towards the wind; and, when I thought proper

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Dr Anderson's method tried.

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per to increase the size of the cocks, I was careful to do it in a fine day, and by this means I secured above 20 loads of good hay in three weeks; but, during the operation, two acres of my grass got wet, before the men who followed the mowers could get into cock: I therefore determined to follow the usual method with these two acres, by tedding and windrowing, which I had performed with as much care as possible; notwithstanding which, the quality of the hay was not half the value of that made in the new way.

Result of
the trial.

“ Upon this process I have to observe, that although it will take a longer time to effect the business, fewer hands are necessary than in the common mode; and I believe one-fourth of the usual expence may be saved; but should it appear, by repeated trials, that the new mode is a *certain* one to preserve the crop of hay in wet weather, an increased length of time should be dispensed with in a climate so subject to wet as this.”

Courland
method.

The following mode of make clover hay in wet weather, lately practised in Courland, is of so singular a nature, that we cannot pass it over unnoticed, though we do not know, that it has yet been tried in this country. The account is extracted from the Transactions of the Society for the encouragement of Arts, Manufactures, and Commerce.—“ In the method of making hay recommended by the Rev. Mr Klapmeyer, not only a number of hands are saved, but the hay is better and more nourishing. The hay is prepared by self-fermentation, whereby it retains its nutritious juices, and only loses its watery particles; it is dried more expeditiously by dissipation of its humidity, and contraction of the sap-vessels, and thus its nutritious juices are concentrated. This process is conducted in the following manner, viz.

The

The sap-vessels are expanded by the circulation of the liquid juices by heat, and the superfluous humidity is exhaled: on cooling, the sap-vessels contract, and thus future intestine fermentation is prevented, and the nutritious quality preserved.

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Upon this principle, the clover intended for hay, after having been mowed, remains till four o'clock in the afternoon of the following day in the swathe, to dry; it must then be raked together into small coils, and afterwards made into large cocks, in the form of a sugar-loaf, and such as would require six or eight horses to remove. To prevent the air from penetrating these cocks, and to produce a quicker fermentation, they must, whilst forming, be trod down by one or two men. If it be a still close warm night, the fermentation will commence in four hours, and manifest itself by a strong honey-like smell: when a proper fermentation is begun, the cocks will, on being opened, smoke, appear brownish, and may then be spread abroad. If in the morning the sun is warm, and a little wind arises, the clover hay will quickly dry; it may then, towards noon, be turned with the rake or pitch-fork; and, about four in the afternoon, will be sufficiently dry, so that it may be immediately carted into the barn, without any danger of a second fermentation.

“By this method of management, the clover will require only three days from the time of mowing to its being housed, and very little work; whilst, in the common way, even in good weather, it requires six or eight days: in the old method, it frequently becomes of a black colour; but, in the new method, it is only brown, has an agreeable smell, and remains good and unchangeable in the barn. The farmer has also an-

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other advantage, that, if he has not carts enough to carry it into the barn, he needs only at sun-setting, to heap it again into large well-trodden cocks, and thatch them with straw; in which state they will remain the whole summer without damage or loss. This clover hay is not only greedily eaten by sheep and lambs, but also by horses, calves, and cows.

“The last, in particular, prefer it to the best meadow hay; it produces a great quantity of rich milk; and the butter made from it is almost as yellow as summer butter.

“As this new mode of making hay depends principally upon two circumstances,—first, that the mown clover, when brought together into large heaps, may ferment equally and expeditiously; secondly, that the day succeeding the fermentation be dry, sunny, and windy—on this account it may be proper to point out what should be done, when circumstances are unfavourable.

“Let us suppose, therefore, that the night after the clover grass has been placed in the great cocks, be cold, damp, or rainy, the fermentation will yet take place, although it may require a term of 12, 16, or 24 hours to effect it. If it be a second or third crop, at which season the nights are colder, it may even require from 36 to 48 hours before the fermentation ensues; it will, however, commence, and may be ascertained from this circumstance, that you can scarcely bear your hand in the interior of the cock.

“Even if the night be dry, yet if a cold strong wind blows, the cock may not ferment equally, but only in the middle and on the side opposite to the wind, the
other

other parts may still remain green. In such a case the following rules must be attended to :

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“ First, If the cock has only fermented in the middle, and, on that side where the cold wind did not act upon it, the whole heap must, nevertheless, be opened the following morning. That which has already fermented, must be separated and spread to dry ; it must be turned towards noon, and may be carted into the barn in the evening ; but that part of the cock, which has not fermented, must be again put together into large cocks, and fermented in the same manner as the preceding part ; after which it may be spread to dry, and brought into the barn.

Rules for
unfavourable
cases.

“ Secondly, In such cases where a small portion of the cock has fermented thoroughly, but not the greater part, the heap must be spread abroad in the morning, but must be again made into a close cock in the evening, in such a manner, that the part which has fermented be placed at the top or outside of the cock, and that which has not fermented be inclosed within it ; then, on the ensuing morning, or if the weather be cold and rainy on the morning afterwards, the clover heap may be again spread abroad, and the clover treated as in case first.

“ Thirdly, If, in spreading the heap abroad, it be found that nearly the whole of the clover has fermented, it will not be necessary to delay the housing of the whole, on account of some small portion ; but the clover may be dried and carted into the barn. The small portion of clover, which remained unfermented, will not occasion any disaster to the other which has fermented ; for there is a material difference betwixt hay thus managed, and the meadow grass which is brought,

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whilst damp or wet with rain, into the barn, which will grow musty and putrid.

“ Fourthly, In such instances, where some of the cocks of clover have thoroughly fermented, and it rains on the morning, they ought to be spread abroad; for the clover must be opened and spread, even if it rains violently; since, if it was suffered to remain long in the heap, it would take fire, or its juices would be injured by too much fermentation, the leaves and stalks would become black and the clover unfit for food; therefore, if the rain continues, the spread clover must be turned from time to time, but not carted into the barn till dry. This drying takes place, if the rain discontinues for a few hours, much more expeditiously with the clover which has fermented, than with that made in the common way. Besides which, it must be remarked, that the fermented clover remains good, even if it continues some weeks exposed to the rain, provided it is at last suffered to dry before it is put into the barn, otherwise the wet from the rain will render it musty and bad. The clover, which has been for so long a time exposed to the rain, will not, however, be so nutritious as that which has been well fermented and sooner dried; but it will be far superior to that which has been exposed to the rain, and got up in the common method.

“ This new method has been adopted, with success, during the years 1768 and 1799, in Walesia, and found in every respect preferable to the old manner. On one of the estates there, it rained much during the hay-time; they were obliged to spread the clover out of the large cocks, owing to its having fermented only in the middle: the parts which had not fermented were
carefully

carefully separated, and made again into large cocks, which fermented at the expiration of 36 hours, rainy weather and cold nights continuing during this period; after which time it was again spread abroad. Reaping
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and Hay. The former, as well as the latter, remained for three days, exposed to the rain, during which period it was turned several times; the rain ceased on the fourth day, so that the clover hay was turned towards noon, and carted into the barn that evening. This clover hay remained in the hay-loft, without change, and was a very nutritious food. Several milch-cows were fed with it, who not only ate it greedily, but also increased in their milk. Lambs and calves also thrived with it greatly. This method of making clover hay prevents its taking fire; for clover, which has been once well fermented and dried, does not change or spoil in the hay-loft.

“ If the weather should be remarkably hot, you may, by adopting this plan, prevent a frequent accident; for grafs, hastily made into hay, however dry it may appear to the hand, contains within its fibres much humidity; and, when trodden down in the stack, will ferment rapidly, from this humidity endeavouring to escape, which often fires the stack. A certain degree of fermentation is necessary in the making of hay, in order to develope its saccharine qualities, and make nutritious food. This saccharine fermentation is evident from the smell and colour of the hay in common stacks; and from tasting an infusion of it. It resembles, in some degree, the process of making malt from barley, and requires a similar attention. I have no doubt, that the method above related will prove generally advantageous in making clover, lucerne, and meadow hay,

Reaping in England, and lead to valuable improvements in agriculture.”

and Storing
up Corn
and Hay. Hay-stack. In the yard, a stack of hay ought to be an oblong square, if the quantity be greater than to be easily stowed in a round stack; because a smaller surface is exposed to the air than in a number of round stacks. For the same reason, a stack of pease ought to have the same form, the straw being more valuable than that of oats, wheat, or barley. The moment a stack is finished, it ought to be covered; because the surface hay is much damaged by withering in dry weather, and moistening in wet weather. Let it have a pavilion-roof; for more of it can be covered with straw in that shape, than when built perpendicular at the ends. Let it be roped as directed above for corn-stacks; with this difference only, that in an oblong square the ropes must be thrown over the top, and tied to the belt-rope below. This belt-rope ought to be fixed with pins to the stack: the reason is, that the ropes thrown over the stack will bag by the sinking of the stack, and may be drawn tight by lowering the belt-rope, and fixing it in its new position with the same pins.

The stems of hops, being long and tough, make excellent ropes; and it will be a saving article, to propagate a few plants of that kind for that very end.

A stack of rye-grass hay, a year old, and of a moderate size, will weigh, each cubic yard, 11 Dutch stone. A stack of clover hay in the same circumstances weighs somewhat less.

SECT. VII.

MANURES.

THERE ~~is~~ no money laid out upon a farm, which pays so well, and which so very rarely disappoints the farmer, as that which he expends for dung or other good manures.

Much has been written, and many ingenious hypotheses presented to the world, concerning those substances which have been supposed to constitute the food of plants, and the modes of applying these substances to different soils, as a preparation for rearing abundant crops. We shall here, however, avoid entering into the consideration of these ingenious and too refined discussions, and shall only remark, that the practical farmer, who wishes to advance safely and prosperously in his occupation, will probably find, that the best principle upon which he can proceed in forming his plans for the preparation of manure, will consist of keeping strictly in view the ideas which we formerly stated *, when considering the theory of agriculture. When we wish to fertilize land by art, we ought to follow nature, or to imitate the process by which she fertilizes it. Vegetable substances fermented by the putrefaction of animal matters, rapidly fall down into the earth, and assume the form of that rich black mould which is the most productive of all soils. The great object of the husbandman,

Practical
rule for
forming
manures.

Manures. bandman, therefore, ought to be to procure large quantities of vegetable substances of every kind, such as straw, stubble, rushes, weeds, &c. and to lay these up to ferment along with the fresh dung of animals, particularly those animals which chew the cud, for by digesting their food in a very perfect manner, their dung contains a large portion of animal matter. As horses, on the contrary, digest their food very weakly, their dung is often only sufficiently animalized to bring on its own fermentation, which, however, is very strong, on account of the large quantity of bits of straw, hay, and other undecomposed parts of their food, which it contains. In the neighbourhood of cities, other animal substances, besides dung, may frequently be obtained; such as bullocks blood, and the refuse of works in which train oil is prepared, none of which ought to be neglected by the husbandman.

The art of fermenting vegetable by animal matters, or the true art of making dung, has not yet been brought to perfection, nor is it in almost any situation sufficiently attended to. In many places, we see large quantities of ferns, rushes, and the coarse grass of bogs, which no cattle will consume, allowed to run to waste; whereas, though these plants do not readily of themselves run into fermentation, they might easily, by proper care, be made to undergo this process, and consequently be converted into a source of riches, that is, into fertile mould. On this subject, we shall here state a mode of preparing dung upon the above principles, that has lately been discovered, and successfully adopted in Mid Lothian by the Hon. Lord Meadowbank, one of the senators of the College of Justice in Scotland. It consists of subjecting common peat-moss to the process of fermentation

mentation now mentioned, and has been explained by ^{Manure.} his lordship, in a small printed pamphlet, of which, though not sold to the public, a considerable number of copies have been distributed among his lordship's friends. It is in the following terms: "It is proper to state in the outset," says his lordship, "some general facts concerning the preparation of manure, which every practical farmer should be acquainted with.

" 1. All recently dead animal or vegetable matter, if sufficiently divided, moist, and not chilled nearly to freezing, tends spontaneously to undergo changes, that bring it at length to be a fat greasy earth, which, when mixed with sands, clays, and a little chalk or pounded limestone, forms what is called rich loam, or garden-mould. ^{Lord Meadowbank's mode of converting muck into manure.}

" 2. In vegetable matter, when amassed in quantities, these changes are at first attended with very considerable heat, (sometimes proceeding the length of inflammation), which, when not exceeding blood-heat, greatly favours and quickens the changes, both in animal matter, and the further changes in vegetable matter, that are not sensibly attended with the production of heat. The changes attended with heat, are said to happen by a fermentation, named from what is observed in making of ale, wine, or vinegar. The latter are ascribed to what is called *putrefactive fermentation*.

" 3. Besides moderate moisture and heat, and that division of parts which admits the air in a certain degree, circumstances which seem to be necessary to the production of these changes, stirring, or mechanical mixture, favours them; and a similar effect arises from the addition of chalk, pounded limestone, lime, rub-
bish

Manures. bish of old buildings, or burnt lime brought back to its natural state; and also of ashes of burnt coal, peat, or wood, soap-leys, foot, sea-shells, and sea-ware. And, on the other hand, the changes are stopped or retarded by pressure or consolidation, excluding air; by much ~~water~~ water, especially when below the heat of a pool in summer; by astringents; and by caustic substances, as quicklime, acids, and pure alkalies, at least till their causticity is mollified, at the expence of the destruction of part of the animal and vegetable matter to which they are added.

“4. These changes are accomplished by the separation or decomposition of the parts or ingredients of which the dead vegetables and animals are composed; by the escape of somewhat of their substance in the form of vapours or gasses; by the imbibing also somewhat from water and from the atmosphere; and by the formation of compound matters, from the reunion of parts or ingredients, which had been separated by the powers of the living vegetables and animals. The earlier changes, and in general those which take place previous to the destruction of the adhesion and texture of the dead vegetables and animals, appear to be rather pernicious than favourable to the growth of living vegetables, exposed to the direct effect of them; whereas the changes subsequent to the destruction of the animal and vegetable texture promote powerfully the growth of plants, and, partly by their immediate efficacy on the plants exposed to their influence, partly by the alterations they produce in the soil, constitute what is to be considered as enriching manure*.

“5. It

* Hot fermenting dung partakes of both sorts of fermentation.

“ 5. It should be the object of the farmer to give Manures. his soil the full benefit of these latter changes, decompositions, and recompositions, which proceed slowly, and continue to go on for years after the manure is lodged in the soil. Even loam or garden-mould is still undergoing some remaining changes of the same sort; and, by frequently stirring it, or removing it, and using it as a top-dressing, its spontaneous changes are so favoured, that it will yield heavy crops for a time, without fresh manure; or, in other words, it is rendered in so far a manure itself, as it decomposes faster than in its ordinary and more stationary state, and, in so doing, nourishes vegetables more abundantly, or forms new combinations in the adjoining soil, that enable it to do so.

“ It should also be the object of the farmer, to employ the more early changes, not only to bring forward the substances undergoing them into a proper state to be committed to the soil, but to accelerate or retard them, so as to have his manure ready for use at the proper seasons, with as little loss as possible, from part being too much and part too little decomposed; and also to avail himself of the activity of those changes, to restore to a state of sufficiently rapid spontaneous decomposition, such substances in his farm, as, though in a state of decay, had become so stationary, as to be unfit for manure, without the aid of heat and mixture.

“ By attention to the two first particulars, and the proper use of compression, stirring, and mixture, the farm dunghill, though formed slowly and of materials in very various states of decay, is brought forward in nearly the same condition. By attention to the latter, manure

Manures. manure may, in most situations in Scotland, be tripled or quadrupled; *et finium est aurum*. On the other hand, by inattention to them, part of the manure is put into the soil unprepared, that is, in a situation where the texture of the vegetable is still entire; and its decomposition never having been carried far by the heat and mixture of a fermenting mass, proceeds in the soil so slowly, that, like ploughed-down stubble, it does not merit the name of manure. Part, again, is apt to be too much rotted, that is, much of it is too nearly approaching to the state of garden-mould, whereby much benefit is lost, by the escape of what had been separated during the process it has undergone, and the good effects on the soil of what remains are less durable; for, between solution in water, and rapid decomposition from its advanced state of rottenness, it is soon reduced to that of garden-mould; and, in fine, the powers of fermenting vegetable with animal matter, which, when properly employed, are certainly most efficacious in converting into manure many substances that are otherwise very stationary and slow in their decomposition, are lost to the farmer, so that he is often reduced to adopt an imperfect and little profitable mode of cultivation, from the want of the manure requisite for a better, though such manure may be lying in abundance within his reach, but useless from his ignorance how to prepare it.

“*Peat-moss* is to be found in considerable quantities within reach of most farms in Scotland, particularly in those districts where outfield land (i. e. land not brought into a regular course of cropping and manuring) forms the larger part of the arable land. It consists of the remains of shrubs, trees, heath, and other vegetables,

vegetables, which, under the influence of a cold and moist climate, and in wet situations, have got into a condition almost stationary, but much removed from that of the recently dead vegetable, and certainly considerably distant from that of garden-mould. It is no longer susceptible of going of itself, though placed in the most favourable circumstances, into that rapid fermentation, accompanied with heat, which masses of fresh vegetables experience: But it is still a powerful fuel when dried; and, on the other hand, it requires long exposure to the seasons, in a dry situation, before, without mixture, it is fit for the nourishing of living vegetables.

“ In general, however, there is nothing in the situation of peat-mosses, or in the changes it has undergone, that leads to think that it has suffered any thing that unfits it to be prepared for manure. It is no doubt found sometimes mixed with particular mineral substances, that may be, for a time, pernicious to vegetation; but, in general, there is no such admixture, and, when it does take place, a little patience and attention will be sufficient to cure the evil. In the ordinary case, the only substances found in peat that may be unfavourable to vegetation, in so far at least as tending to keep it stationary and prevent its rotting, are two, and both abounding in fresh vegetables of the sorts of which moss is chiefly composed: These are, gallic acid, and the astringent principle or tan; and as these are got the better of in fresh vegetables by the hot fermentation to which they are subject, so as to leave the general mass of the substances to which they belonged properly prepared manure, there is no reason to suppose, that the same may not be accomplished with
the

Manures.

Manures. the acid and tan of peat Again, the powers of peat as a fuel, and of ashes of peat as a manure, ought to convince every person, that the material and more essential parts of the dead vegetable, for the formation of manure, remain entire in peat. Here the inflammable oils and carbonaceous matter which abound in the fresh vegetable, and the latter of which also abounds in garden-mould, remain entire; the soot and ashes, too, which are the results of the inflammation of each, seem to be nearly equally fertilizing; and, in short, little seems to be lost in peat but the effects of the first fermentation in preparing the matter to undergo its future changes with the rapidity requisite to constitute manure. Besides, the soil produced from peat-earth, by exposure for a course of years, seems not to be sensibly different from that obtained from dung in the same way. Both are deficient in firmness of texture; but are very prolific when mixed with clays, sand, and calcareous earths, in due proportion.

“ From considering the preceding circumstances, and from trying what substances operated on tan, and on the acid found in peat-moss, it was determined to subject it to the influence of different sorts of fermenting dung, with due attention to the proportions used, and to the effects of the different preparations; and the following is the direction, which an experience of six crops recommends to practice.

“ Let the peat-moss of which compost is to be formed, be thrown out of the pit for some weeks or months, in order to lose its redundant moisture. By this means, it is rendered the lighter to carry, and less compact and weighty, when made up with fresh dung, for fermentation; and accordingly less dung is required for the purpose,

pose, than if the preparation is made with peat taken Manures. recently from the pit.

“Take the peat-moss to a dry spot, convenient for constructing a dunghill, to serve the field to be manured. Lay it in two rows, and dung in a row betwixt them: the dung thus lies on the area of the compost-dunghill, and the rows of peat should be near enough each other, that workmen, in making up the compost, may be able to throw them together by the spade, without wheeling. In making up, let the workmen begin at one end. Lay a bottom of peat, six inches deep, and 15 feet wide, if the ground admit of it*. Then lay about 10 inches of dung above the peat; then about six inches of peat; then four or five of dung, and then six more of peat; then another thin layer of dung; and then cover it over with peats at the end where it was begun, at the two sides, and above. It should not be raised above four feet, or four and a half feet high, otherwise it is apt to press too heavily on the under part, and check the fermentation. When a beginning is thus made, the workmen will proceed working backwards, and adding to the column of compost, as they are furnished with the three rows of materials, directed to be laid down for them. They must take care not to tread on the compost, or render it too compact; and of consequence, in proportion as the peat is wet, it should be made up in lumps, and not much broken.

“In mild weather, seven cart-loads of common farm-dung, tolerably fresh made, is sufficient for 21 cart-loads

* This alludes to the propriety, in clay lands, of suiting the dunghill to the breadth of a single ridge, free of each furrow.

Manures. loads of peat-moss; but in cold weather, a larger proportion of dung is desirable. To every 28 carts of the compost, when made up, it is of use to throw on above it a cart-load of ashes, either made from coal, peat, or wood; or if these cannot be had, half the quantity of flaked lime may be used, the more finely powdered the better. But these additions are nowise essential to the general success of the compost.

“The dung to be used should either have been recently made, or kept fresh by compression; as, by the treading of cattle or swine, or by carts passing over it. And if there is little or no litter in it, a smaller quantity will serve, provided any spongy vegetable matter is added at making up the compost, as fresh weeds, the rubbish of a stack-yard, potato-shaws, sawings of timber, &c. And as some sorts of dung, even when fresh, are much more advanced in decomposition than others, it is material to attend to this; for a much less proportion of such dung, as is less advanced, will serve for the compost, provided care is taken to keep the mass sufficiently open, either by a mixture of the above-mentioned substances, or, if these are wanting, by adding the moss piece-meal, that is, first mixing it up in the usual proportion of three to one of dung, and then, after a time, adding an equal quantity, more or less, of moss. The dung of this character, of greatest quantity, is shamble-dung, with which, under the above precautions, six times the quantity of moss, or more, may be prepared. The same holds as to pigeon-dung, and other fowl-dung; and to a certain extent, also, as to that which is collected from towns, and made by animals that feed on grains, refuse of distilleries, &c.

“The

“ The compost, after it is made up, gets into a general heat, sooner or later, according to the weather and the condition of the dung : in summer, in ten days or sooner ; in winter, not perhaps for many weeks, if the cold is severe. It always, however, has been found to come on at last ; and in summer, it sometimes rises so high, as to be mischievous, by consuming the materials, (fire-fanning). In that season, a stick should be kept in it in different parts, to pull out and feel now and then : for if it approaches to blood-heat, it should either be watered, or turned over ; and on such an occasion, advantage may be taken to mix it with a little fresh moss. The heat subsides after a time, and with great variety, according to the weather, the dung, and the perfection of the making up of the compost ; which then should be allowed to remain untouched, till within three weeks of using, when it should be turned over, upside down, and outside in, and all lumps broken : then it comes into a second heat ; but soon cools, and should be taken out for use. In this state, the whole, except bits of the old decayed wood, appears a black free mass, and spreads like garden-mould. Use it, weight for weight, as farm-yard dung ; and it will be found, in a course of cropping, fully to stand the comparison.

“ The addition recommended of ashes or lime, is thought to favour the general perfection of the preparation, and to hasten the second heat. The lime laid on above the dunghill, as directed, is rendered mild by the vapours that escape during the first heat.

“ Compost, made up before January, has hitherto been in good order for the spring-crops ; but this may not happen in a long frost. In summer, it is ready in

Manures. eight or ten weeks; and if there is an anxiety to have it soon prepared, the addition of ashes, or of a little lime-rubbish of old buildings, or of lime, flaked with foul water, applied to the dung used in making up, will quicken the process considerably.

“Lime has been mixed previously with the peat; but the compost prepared with that mixture, or with the simple peat, seemed to produce equally good crops. All the land, however, that it has been tried on, has been limed more or less, within these 25 years.

“Peat prepared with lime alone, has not been found to answer as a good manure. In one instance, viz. on a bit of fallow sown with wheat, it was manifestly pernicious. Neither with cow-water alone is it prepared, unless by lying immersed in a pool of it for a long time, when it turns into a sort of sleetch, which makes an excellent top-dressing. Something of the same sort happens with soap-suds, and water of common sewers, &c. Lime-water was not found to unite with the tan in peat, nor was urine *. Peat made up with seaweed gets into heat, and the peat seems to undergo the same change as when prepared with dung. But the effect of this preparation on crops has not yet been experienced. Peat has also been exposed to the fumes
of

* Tan combines with animal gelly, and loses its astringency. The animalized matter, extricated in fermenting dung, has probably this effect on the tan in peat, as well as to render the acid innocent. As vegetable matters seem in general to contain the ingredients of, and are often somewhat similar to, animal gluten, it is possible that the fermentation of fresh vegetables alone may prove sufficient to prepare the peat to rot in the soil expeditiously; but it is certainly desirable to use also animalized matter for this purpose.

of a putrefying carcase. In one instance the peat proved a manure; but much weaker than when prepared with dung. There, however, the proportion used was very large to the carcase. Other trials are making, Manures. where the proportion is less, and with, or without, the addition of ashes, lime, &c. In all these cases, there can be no sensible heat. Peat, heated and rendered friable by the action of the living principle of turnips in growing, was not found entitled, when used as top-dressing, to the character of manure. It had been made up in the view of preserving the turnips during frost. But the turnips sprung, and the mass heated. The turnips were taken out, and the peat afterwards used as a top-dressing. Peat is now under trial, as preparing with turnips and fresh weeds, in fermentation, without the admixture of any animalized matters.

“It is said that dry peat-earth is used as a manure in some parts in England. But unless in chalky soils, or others where there may be a great want of carbonaceous matter, it is much doubted whether it could be used with any sensible advantage. Peat-ashes were found to raise turnips, but to have no sensible effect on the next crop.

“The quantity of the compost used per acre has varied, considerably, according to the richness of the soil manured, and the condition in which it is at manuring, and the season in which the manure is applied. From 23 to 35 cart load, by two horses each, is about what has been given; the lesser to fallows and ground in good tilth, and the larger when to be ploughed in with the sward of poor land; and the intermediate quantities, with tares, peas, potatoes, &c.; and it has in most

Manures. cases undergone comparative trials with different sorts of common dung.

“ It may be proper to add, that too much attention cannot be paid to the proper preparation of the ground for the reception of manure. It should be clean, pretty dry at the application, and well mixed and friable. Much of the manure applied is otherwise lost, whether lime, dung, or compost. The additional quantities recommended when the land is coarse, is just so much that would have been saved by better cultivation. Common farmers are little aware of this. They might save at least half their lime, did they lay it on in powder *, and on fallows, only harrowing it, and letting it wait for a shower before it is ploughed in; and perhaps not much less of their dung. It is astonishing what a visible effect is produced on land properly mixed by a fallow, from the addition of only a very small quantity of properly prepared dung or compost. Both its texture and colour undergo a very sensible change, which cannot be accounted for, except from the extrication of substances from the decomposing manure, (probably from its spontaneous tendency to decompose being aided by the chemical action of various matters in a soil so prepared): And from these substances operating in the soil, numberless compositions and decompositions, or tendencies to them, take place, from the various elective attractions of the different parts of which it is composed. It is obvious, that an immensely

* This they may, though driven in winter, and drowned in heaps by rains. They have only to turn it over with a very small additional quantity of new burnt shells when they come to use it.

ly greater proportion of manure must be required to Manures. produce even a little of this, where the soil is coarse or lumpy, or consolidated by wetness, than when put into a situation favourable to the reciprocal action of the various substances contained in it, a variety and an admixture formed by nature in perfection in the more favoured soils, (as in the bottom of drained lakes, haughs, Delta ground), and which it is the business of the skilful and industrious farmer to form, or make compensation for the want of, by judicious manuring, where nature has been less bountiful of her gifts.

“ It was meant to have given a detailed account of many of the experiments that have been made, whether in agriculture or chemistry. But as these are still going on, and the practical results have attracted some attention, and prompted imitation by neighbours and acquaintance, so that manuscript directions have been often applied for and obtained; it has been preferred to print, in the mean time, this short account of the business, divested of scientific language, and suited to the perusal of any practical husbandman. It was indeed felt as a degree of wrong, not to take some steps to make it public as soon as the certainty of success warranted. And both the power and the duration of the manure have now stood the test of a great variety of trials, on a considerable extent of ground, and of much diversity of soil, continued without intermission during the last six years. Hitherto it has been found equal, and indeed preferable, to common farm-yard dung, for the first three years, and decidedly to surpass it afterwards. It has been conjectured, from the appearance and effects of the compost, that its parts are less volatile and soluble than those of

Manures. dung; but that it yields to the crop what is requisite, by the action of the living fibres of vegetables; and in this way wastes slower, and lasts longer. Whatever be in this, nothing has appeared more remarkable, than its superiority in maintaining (~~for four and five~~ years) fresh and nourishing, the pasture of thin clays, that had been laid down with it, and in making them yield well when again ploughed, and that without any top-dressing, or new manure of any sort. Employed in this way, the effect of common dung is soon over, the soil becoming consolidated, and the pasture stunted; and hence such soils have not usually been cultivated with advantage, except by tillage, and by the aid of quantities of manure, got by purchase, and much beyond the produce of the farm-yard. It is believed that the foregoing directions will, if practised, prove beneficial to every farmer who has access to peat-moss, within a moderate distance; but it is to the farmers of the soil now mentioned, and of hungry gravels, to whom they would be found particularly valuable.

“ Let it be observed, that the object in making up the compost is to form as large a hot-bed as the quantity of dung employed admits of, and then to surround it on all sides, so as to have the whole benefit of the heat and effluvia. Peat, as dry as garden-mould, in seed-time, may be mixed with the dung, so as to double the volume and more, and nearly triple the weight, and instead of hurting the heat prolong it. Workmen must begin with using layers; but, when accustomed to the just proportions, if they are furnished with peat moderately dry, and dung not lost in litter, they throw it up together as a mixed mass; and they improve in the art,

so as to make a less proportion of dung serve for the pre-
paration." Manures.

With regard to the other kinds of manure common-
ly in use in this country, their efficacy is well known; Of the more
common
kinds of
manure,
the only difficulty is to procure them in sufficient quan-
tity. In such lands as lie near the sea, sea-weeds offer
an unlimited quantity of excellent manure. In the
neighbourhood of rivers, the weeds with which they
abound offer likewise an excellent manure in plenty.
Oil-cake, malt-coombs, the refuse of slaughter-houses,
&c. all are excellent where they can be got: but the
situations which afford these are comparatively few; so
that in most cases the farmer must depend much on his
own ingenuity and industry for raising a sufficient quan-
tity of dung to answer his purposes; and the methods
taken for this purpose vary according to the situation of
different places, or according to the fancy of the hus-
bandman.

At a distance from towns the farmer must evident-
ly depend for his best manure upon the numbers of
cattle he keeps, and the mode in which he manages
their dung in making it up into farm-yard compost.
His first rule ought to be, to sell from his farm as little
as possible of the hay or straw, but rather to consume
them in making manure. It is only by doing so that he
can possibly expect to see his lands in a train of con-
stant improvement. For the management of the farm-
yard the following, among other rules, are laid down Rules for
producing
farm-yard
dung.
in vol. xxiii. of the Annals of Agriculture. "At the
most leisure season before the time of confining his
cattle to fodder, so much marl, turf, dry mud, loam,
&c. should be carted into the farm-yard, as will cover
the whole about 12 inches deep; and if there are many

Manures. stables, hog-houses, bullock or cow-stalls, that are cleaned into it, to spread such earth thicker in those places. Those who have the fortunate opportunity of using bog-peat from the vicinity of a bog or boggy bottom should not neglect it; such stuff is a vegetable dunghill.

**Litter of
Stubble.**

“ Before he begins to fodder, which will be probably some time in November, let him litter the whole yard well with either stubble, fern, or leaves. For this purpose, I suppose all his wheat stubbles mown, chopped, or hochled (as it is termed in some counties), and stacked in or very near the yards. If he is near a warren, heath, or common, he may probably be able to procure fern cheap; that is, at the price of eight or ten shillings a waggon load, in bulk equal to a ton and a half of dry-hay; wherever such opportunities exist, they ought never to be neglected.

“ If his neighbours will sell their stubble at 12s. to 15s. a waggon-load delivered in, he ought to provide a large quantity.

Fern.

“ Fern, in burning, yields more alkaline salts than any other vegetable, which is proof sufficient how valuable the dung must be; but care must be taken to rot it well, which is more difficult than to rot straw.

“ No money which a farmer can expend is better laid out than in the purchase of litter of any kind; for his cattle do not only lie dry, warm, and bedded, but the quantity of manure he raises is very large, and cheaper than in any other way of buying it.

Leaves.

“ The other article I named, *leaves*, depends on his situation. If he is in a woodland, where the trees are thick and spreading, they are to be raked into heaps, and

and carted to the farm-yard, at a very moderate ex-
pence; they make excellent litter, and very good dung. ^{Manures.}
If he has any marshes in his neighbourhood that afford
a good swarth of rushes, coarse grass, flags, &c. he ^{Rushes, &c.}
should not neglect to lay in good store of these for the
same use; and if he has the power of cutting the aqua-
tics that rise under water in lakes or meres, or flooded
ground, he may do it by jointed scythes, and rake them
into boats.

“These steps being taken, the farmer is well pre-
pared to meet the winter, and to turn it greatly to his
advantage; but, in order to this, he must adopt that
husbandry which this climate points out as necessary;
but which those commonly esteemed more happy are
exempted from, and consequently tempt farmers to ne-
glect this necessary business of making dung. The ma-
nagement I mean is the strict confinement of his cattle ^{Confinement of cattle in winter.}
during winter. Some curious cattle masters tie them
up in stalls: I do not require it; but it is essential that
they are confined to the yard, and on no account suf-
fered to roam about any pastures, which is a practice
too common. If all the cattle of a farm are absolutely
confined to the yard, the lean stock to straw, and the
rest to straw and turnips, &c. or to hay, the compost
of marl, litter, and waste straw, will have the necessary
quantity of animal manure amongst it to ferment, rot,
and turn to rich manure; whereas, if the cattle do not
live entirely in the farm-yard, the heap may be large,
but of little value.

“The common error to be seen in the management ^{Yard-drain-}
of half the yards in the kingdom is suffering the drain-
ings to run to waste. Rain and snow will, in spite of
any management, sometimes overflow; but, in general,
the

Manures. the whole may be under command. The best method is to sink a well about five feet deep in the lowest corner of the yard, to fix a pump in it, and to raise a small stage whereon to stand and to work it; a trough will then convey the water to a large heap of marl, chalk, turf, loam, &c.; and daily pumping over it, will make it of little less value than a heap of dung of the same size. The whole expence of what is necessary for this will be under four pounds; and that of pumping is too trifling to think of. The dung should never be suffered to remain under water, however rich it may be, as putrefaction is in that case stopped.

Dung not to be much stirred. “Many persons turn over their dunghills frequently, in order that they may rot the sooner; but I have often observed, that no dung becomes so thoroughly and equally converted into a mucilaginous mass, into black butter, as the farmers call it, as that which never was stirred at all. By moving the dung is made to lie loose and hollow; every fresh fermentation that is excited in that state volatilizes the oil and alkaline salt, and carries it off to the atmosphere. Hence we see, that a dunghill often stirred or moved, though black and rotten, is by far drier than one which has remained untouched; and it is the fat oily wet rottenness that is valuable, that is mucilaginous. The longer you keep, and the oftener you mix your dung, the drier it becomes, till at last it has the appearance of black snuff, and might be sown by hand. Hence, therefore, to avoid too much stirring and moving (which, by the way, is very expensive also), I would let it rest in the farm-yard till the land is ready it is designed for, and fodder in another yard. If the buildings and conveniences will not allow this, then in the spring, as soon as the
foddering

foddering is over, I would, instead of turning over, ^{Manures.} cart it at once out of the yard into a heap, taking care to mix the marl with the litter as well as possible in filling the carts, and making the heap in the field where it is to be used, leaving it untouched; in which way the dung has but one stirring also. The heap should not be above four feet thick, and not carted upon; and if it is put in a shady place, under thick spreading trees, so much the better."

The common folding of sheep is well known in ^{Covered} many parts of the kingdom; but the covered fold is ^{sheep-fold.} nowhere general in Britain. In various parts of Europe, however, it is regularly done, and among the Romans it was common husbandry. "The method I would recommend (says the above writer), is to open some out-house adjoining the farm-yard; or build a flight shed in any convenient part of the farm, inclosed with a high pale, in such a manner that the sheep may either be under cover, or exposed to the weather, as they pleased; that is, to have an apartment sheltered, and a small area before it inclosed. The whole to be covered with marl, turf, or loam, 12 inches deep, and then well littered regularly through the winter with whatever litter the farmer has in plenty. The advantage of this practice is very great; a few sheep cannot be folded in the common manner with any profit; for the expence and trouble of constantly moving the hurdles will overbalance it; but in the standing fold, the case is different; a score of sheep will in a winter make a dunghill that is a real object. The value of the dung raised thus, is much greater than any one can suppose that has not tried it. Ewes and their lambs in cold driving rain and snow, lie sheltered and warm, and do
much

Manures. much better than when exposed to such weather, especially if you give them hay in racks, which should be always practised in such standing folds.

"It is said, that in Flanders, where this husbandry is practised, they strew their houses with sand instead of litter."

**Crops
ploughed
in.**

The "system of manuring by means of green vegetables (this writer adds), has many advocates, and there have been instances of its being attended with great success. It consists in ploughing in a full crop of some succulent vegetable, such as clover, buckwheat or tares. To make them turn in well, two circumstances are necessary; they must have a barley roller run over them, a trench-plough must follow, going the same way as the roller did. A common plough will do it very incompletely, for they are not entirely buried; if the points stick out between the furrows, they will not die, and consequently not ferment: but Mr Duckett's trench-plough buries completely. This work should always be done in summer, or very early in autumn, while the sun has power to forward the fermentation, for in winter little or no use would result from the practice. The benefit will depend on circumstances; but chiefly, I should apprehend, on the disposition of the soil to promote and forward the putrefactive fermentation. If the mass of vegetables is speedily converted by putrefaction into mucilage, there can be no doubt but you acquire manure. And this will depend on the weather: if a very cold, or cold and wet season followed, the whole perhaps might be nearly lost; but if the weather is moderately moist and very warm, the fermentation will be speedy. Nothing less than a very great crop should be ploughed in; a large mass putrefies in a quite different

ferent manner from a small one: a thin crop might not putrefy at all, that is, in union with the land. A degree of putrefaction ensues wherever any animal dungs, but the soil is very little better for it; but turn in so much dung, that the incumbent earth and the dung shall together feel an excited fermentation, the benefit will be great. But after all, that question yet remains, whether a great crop of clover, buck-wheat, and tares, mown green, for soiling in the farm, will not, in the consumption by cattle yield more and better manure than can result from ploughing them in. I must own, in my opinion, they might.”

This writer very sensibly adds, that “the young farmer should be sensible of the importance of all animal substances, which are greatly preferable to all vegetable manures, many kinds being procurable in great cities; curriers shavings, woollen rags, hogs hair, feathers, offals of butchers and fishmongers stalls and kennels, trotters, horn shavings, &c. It should be received as a maxim, that all animal substances whatever make admirable manures, much better than any thing in the vegetable or fossil kingdoms; and this should not only direct him in the purchase of his manures; but also to be very attentive in preventing any such substances in his own house and farm being wasted: the compost dunghill should be the general receptacle of all such. I must, however, observe, that some of these substances are sold at such high prices, that common dung is a better purchase. Compost of fish is excellent.”

In Norfolk, Mr Marshal tells us, that the quality of dung is attended to with greater precision than in most other districts. *Town-muck*, as it is called, is held in most estimation; and the large towns, Norwich

Manures.

Animal manures

In Norfolk, what dung valued.

Manures. wick and Yarmouth, supply the neighbouring country. As Yarmouth, however, is a maritime place, and otherwise in a manner surrounded by marshes, straw is of course a scarce and dear article; whence, instead of littering their horses with it, they use sand. As the bed becomes soiled or wet, fresh sand is put on, until the whole is in a manner saturated with urine and dung, when it is cleared away, and reckoned muck of such excellent quality, that it is sent for from a very great distance. With regard to other kinds of dung, that from horses fed from hay and corn is looked upon to be the best; that of fattening cattle the next; while the dung of lean cattle, particularly of cows, is supposed to be greatly inferior, even though turnips make part of their food. The dung of cattle kept on straw alone is looked upon to be of little or no value; while the muck from trodden straw is by some thought to be better than that from the straw which is eaten by the lean stock.—Composts of dung with earth or marl are very generally used.

In the mid-
land di-
strict.

In the midland counties of England, Mr Marshal informs us, the cores of horns crushed in a mill have been used as manure; though he knows not with what success. His only objection is the difficulty of reducing them to powder. Dung is extremely dear in Norfolk; half a guinea being commonly given for a waggon-load driven by five horses. Great quantities of lime and marl are found in this district. With regard to the method of raising dung in general, perhaps the observations of Mr Marshal upon the management of the Yorkshire farmers may be attended to in addition to what has been already stated.

“ The

“ The general practice (says he) is to pile the dung ^{Manures.} on the highest part of the yard; or, which is still ^{M. Mar-} less judicious, to let it lie scattered about on the side ^{Gail's direc-} of a slope, as it were for the purpose of dissipating ^{tions for} its virtues. The urine which does not mix with the ^{raising} dung is always invariably led off the nearest way to the common sewer, as if it were thought a nuisance to the premises. That which mixes with the dung is of course carried to the *midden*, and assists in the general dissipation. A yard of *dung*, nine-tenths of which are straw, will discharge, even in dry weather, some of its more fluid particles; and in rainy weather, is, notwithstanding the straw, liable to be washed away if exposed on a rising ground. But how much more liable to waste is a mixture of dung and urine, with barely a sufficiency of straw to keep them together? In dry weather the natural oozing is considerable; and in a wet season every shower of rain washes it away in quantities. The Norfolk method of bottoming the dung-yard with mould is here indispensably necessary to common good management. There is no better manure for grass-lands than mould saturated with the oozing of a dunghill: it gets down quickly among the grass, and has generally a more visible effect than the dung itself. Under this management the arable land would have the self-same dung it now has; while the grass-land would have an annual supply of riches, which now run to waste in the sewers and rivulets. But before a dung-yard can with propriety be bottomed with mould, the bottom of the yard itself ought to be properly formed. A part of it, situated conveniently for carriages to come at, and low enough to receive the entire drainings of the stable, cattle-stalls, and hog-sties, should be hollowed

Manures.

lowed out in the manner of an artificial drinking-pool, with a rim somewhat rising, and with covered drains laid into it from the various sources of liquid manure. During the summer months, at leisure times, and embracing opportunities of back-carriage, fill the hollow nearly full with mould, such as the scourings of ditches, the shovellings of roads, the maiden earth of lanes and waste corners, the coping of stone-quarries, &c. &c. leaving the surface somewhat dished; and within this dish set the dung-pile, carefully keeping up a rim of mould round the base of the pile higher than the adjoining surface of the yard; equally to prevent extraneous matter from finding its way into the reservoirs, and to prevent the escape of that which falls within its circuit."

Of lime as a manure.

The use of lime, as a manure, was formerly mentioned*, and also the principle upon which its value depends. It ought to be used not for the purpose of giving food to the plants, but as a stimulant, tending to bring the soil into activity, by reducing to mould all the dead roots of vegetables with which it may abound. Hence it ought never to be used without dung upon soils that have been exhausted by repeated cropping, and that are in a clean state.

Its operation.

However people may differ in other particulars, all agree, that the operation of lime depends on its intimate mixture with the soil; and therefore that the proper time of applying it, is when it is perfectly powdered, and the soil at the same time in the highest degree of pulverization. Lime of itself is absolutely barren; and

* Vol. i. p. 122, &c.

and yet it enriches a barren soil. Neither of the two ^{Manures.} produces any good effect without the other; and consequently, the more intimately they are mixed, the effect must be the greater.

Hence it follows, that lime ought always to be flaked with a proper quantity of water, because by that means it is reduced the most effectually into powder. Lime left to be flaked by a moist air, or accidental rain, is seldom or never thoroughly reduced into powder, and therefore can never be intimately mixed with the soil. Sometimes an opportunity offers to bring home shell-lime before the ground is ready for it; and it is commonly thrown into a heap without cover, trusting to rain for flaking. The proper way is, to lay the shell-lime in different heaps on the ground where it is to be spread, to reduce these heaps into powder by flaking with water, and to cover the flaked lime with sod, so as to defend it from rain. One, however, should avoid as much as possible the bringing home lime before the ground be ready for it. Where allowed to lie long in a heap, there are two bad consequences: first, lime attracts moisture, even though well covered, and runs into clots, which prevents an intimate mixture; and, next, we know that burnt limestone, whether in shells or in powder, returns gradually into its original state of limestone both chemically and mechanically, for it loses its caustic quality, and becomes so hard bound together as to require a pick to separate the parts.

For the same reason, it is a bad practice, though common, to let spread lime lie on the surface all winter. The bad effects above mentioned take place here in part: and there is another, that rain washes the

Manures. lime down to the furrows, and in a hanging field carries the whole away.

**Time of
liming.**

As the particles of powdered lime are both small and heavy, they quickly sink to the bottom of the furrow, if care be not taken to prevent it. In that view, it is a rule, that lime be spread and mixed with the soil immediately before sowing, or along with the seed. In this manner of application, there being no occasion to move it till the ground be stirred for a new crop, it has time to incorporate with the soil, and does not readily separate from it. Thus, if turnip-feed is to be sown broad-cast, the lime ought to be laid on immediately before sowing, and harrowed in with the seed. If a crop of drilled turnip or cabbage be intended, the lime ought to be spread immediately before forming in drills. With respect to wheat, the lime ought to be spread immediately before seed-furrowing. If spread more early, before the ground be sufficiently broken, it sinks to the bottom. If a light soil be prepared for barley, the lime ought to be spread after seed-furrowing, and harrowed in with the seed. In a strong soil, it sinks not so readily to the bottom, and therefore, before sowing the barley, the lime ought to be mixed with the soil by a brake. Where moor is summer-fallowed for a crop of oats next year, the lime ought to be laid on immediately before the last ploughing, and braked in as before. It has sufficient time to incorporate with the soil before the land be stirred again.

Quantity. The quantity to be laid on depends on the nature of the soil. Upon a strong soil, 70 or 80 bolls of shells are not more than sufficient, reckoning four small fir-lots to the boll, termed *wheat measure*, nor will it be an
overflow

overdose to lay on 100 bolls. Between 50 and 60 may suffice upon medium soils; and upon the thin or gravelly, between 30 and 40. It is not safe to lay a much greater quantity on such soils. Manures.

It is common to lime a pasture-field immediately before ploughing. This is an unsafe practice; it is thrown to the bottom of the furrow, from which it is never fully gathered up. The proper time for liming a pasture-field, intended to be taken up for corn, is a year at least, or two, before ploughing. It is washed in by rain among the roots of the plants, and has time to incorporate with the soil. Liming pasture-fields.

Limestone beat small makes an excellent manure; and supplies the want of powdered lime where there is no fuel to burn the limestone. Beat limestone. Limestone beat small has not hitherto been much used as a manure; and the proportion between it and powdered lime has not been ascertained. What follows may give some light. Three pounds of raw lime are by burning reduced to about two pounds of shell-lime. Yet nothing is expelled by the fire but the air that was in the limestone: the calcareous earth remains entire. *Ergo*, two pounds of shell-lime contain as much calcareous earth as three pounds of raw limestone. Shell-lime of the best quality, when flaked with water, will measure out to thrice the quantity. But as limestone loses none of its bulk by being burnt into shells, it follows, that three bushels of raw limestone contain as much calcareous earth as six bushels of powdered lime; and consequently, if powdered lime possess not some virtue above raw limestone, three bushels of the latter beat small should equal as a manure six bushels of the former.

The goodness of marl, as a manure, depends on Marl.

Manures. the quantity of calcareous earth in it: which has been known to amount to a half or more. It is too expensive if the quantity be less than a third or a fourth part. Good marl is the most substantial of all manures; because it improves the weakest ground to equal the best borough-acres. The low part of Berwickshire, termed *the Merse*, abounds everywhere with this marl; and is the only county in Scotland where it is plenty.

Land ought to be cleared of weeds before marling; and it ought to be smoothed with the brake and harrow, in order that the marl may be equally spread. Marl is a fossil on which no vegetable will grow; its efficacy depends, like that of lime, on its pulverization, and intimate mixture with the soil. Towards the former, alternate drought and moisture contribute greatly, as also frost. Therefore, after being evenly spread, it ought to lie on the surface all winter. In the month of October it may be roused with a brake; which will bring to the surface, and expose to the air and frost, all the hard parts, and mix with the soil all that is powdered. In that respect it differs widely from dung and lime, which ought usually to be ploughed into the ground without delay. Oats are a hardy grain, which will answer for the first crop after marling better than any other; and they will succeed though the marl be not thoroughly mixed with the soil. In that case, the marl ought to be ploughed in with an ebb furrow immediately before sowing, and braked thoroughly. It is ticklish to make wheat the first crop: if sown before winter, frost swells the marl, and is apt to throw the seed out of the ground; if sown in spring, it will suffer more than oats by want of due mixture.

Summer

Summer is the proper season for marling; because in ^{Manures} that season the marl, being dry, is not only lighter, but is easily reduced to powder. Frost, however, is not improper for marling, especially as in frost there is little opportunity for any other work.

Marl is a heavy body, and sinks to the bottom of the furrow, if indiscreetly ploughed. Therefore it is generally understood, that the first crop should always have an ebb furrow. During the growing of that crop, the marl has time to incorporate with the soil, and to become a part of it; after which it does not readily separate.

Of late a new manure has been introduced into some ^{Of gypsum as a ma-} countries. This is gypsum, which is lime united with sulphuric acid. In the eighth volume of the Annals of Agriculture we are informed, that it is commonly used as a manure in Switzerland. In the 10th volume of the same work, Sir Richard Sutton gives some account of an experiment made with it on his estate; but in such an inaccurate manner, that nothing could be determined. "The appearance in general (says he), I think, was rather against the benefit of the plaster, though not decidedly so." He tells us, that its virtues were a subject of debate in Germany. In America this substance seems to have met with more success than in any other country. In the fifth volume of the Bath Papers, Mr Kirkpatrick of the Isle of Wight, who had himself visited North America, informs us, that it is much used in the United States, on account of its cheapness and efficacy; though, from what is there stated, we must undoubtedly be led to suppose, that its *efficacy* must be very great before it can be entitled to the praise of *cheapness*. In the first place, it is brought from the hills

Manures. in the neighbourhood of Paris to Havre de Grace, and from thence exported to America ; which of itself must occasion a considerable expence, though the plaster were originally given *gratis*. In the next place, it must be powdered in a stamping mill, and the finer it is powdered so much the better. In the third place, it must be *sown* over the ground to be manured with it. The quantity for grafs is six bushels to an acre. It ought to be sown on dry ground in a wet day ; and its efficacy is said to last from seven to twelve years. It operates entirely as a top-dressing.

In the 10th volume of the Annals of Agriculture, we have some extracts from a treatise by Mr Powel, president of the Philadelphia Society for encouraging Agriculture, upon the subject of gypsum as a manure ; of the efficacy of which he gives the following instances : 1. In October 1786, plaster of Paris was sown in a rainy day upon wheat-stubble without any previous culture. The crop of wheat had scarce been worth reaping, and no kind of grafs seed had been sown upon the ground ; nevertheless, in the month of June it was covered with a thick mat of white clover, clean and even, from six to eight inches in height. A piece of ground adjoining to this white clover was also sown with gypsum, and exhibited a fine appearance of white and red clover mixed with spear-grafs. Some wet ground sown at the same time was not in the least improved.—This anecdote rests entirely on the veracity of an anonymous farmer. 2. Eight bushels of plaster of Paris spread upon two acres and a half of wheat-stubble ground, which the spring before had been sowed with about two pounds of red clover-seed to the acre for pasture, yielded five tons of hay by the middle of

June 2.

June. A small piece of ground of familiar quality, but ^{Manures.} without any plaster, produced only one ton and a half in the same proportion.—Mr Powel concludes in favour of the effects of the plaster upon arable as well as grassland.

Other accounts to the same purpose have been published; though it must also be remarked, that various persons who have made trial of this manure, declare themselves dissatisfied with it; but it does not appear that it has hitherto been at all tried in this part of the island.

We are informed in the 12th volume of the Annals of Agriculture, that in Cornwall, large quantities of sea-sand are annually conveyed to the land, and laid upon the soil; a practice which will no doubt have a tendency to ameliorate stiff clays, and to render them more pervious to the roots of plants. With the same view, and also to save fuel, a practice is said to exist in the Netherlands, of baking up the dross or culm of coal, and also peat-earth, with clay, into lumps or bricks, which when dried in the air, make excellent fuel, and also afford an immense quantity of valuable ashes to be laid upon the land.

We cannot quit this subject of manures, without taking notice of an essay upon it by the celebrated chemist and mineralist Richard Kirwan, Esq. He remarks, that the only substances common to growing vegetables, and to the soils on which they grow, are water, coal, different earths, and salts; and that these, ^{Kirwan on manures. Food of plants.} therefore, must be the true food of vegetables. He observes, that grasses and corn absorb and perspire during the time of their growth about one half their weight of water each day, if the weather be favourable. "With

Manures.
 Coal.

 regard to coal, it not only forms the *residuum* of all vegetable substances that have undergone a slow and smothered combustion, that is, to which the free access of air has been prevented, but also of all putrid vegetable and animal bodies. Hence it is found in vegetable and animal manures, and is the true basis of their ameliorating powers. If the water that passes through a putrefied dunghill be examined, it will be found of a brown colour, and if subjected to evaporation, the principal part of the residuum will be found to consist of coal. All soils steeped in water communicate the same colour to it in proportion to their fertility; and this water being evaporated, leaves also a coal, as Mr Hassenfratz and Fourcroy attest. They also observed, that shavings of wood being left in a moist place for nine or ten months, began to receive the fermentative motion; and being then spread on land, putrefied after some time, and proved an excellent manure. Coal, however, cannot produce its beneficial effects but in as much as it is soluble in water. The means of rendering it soluble are not as yet well ascertained; nevertheless it is even now used as a manure, and with good effect. In truth, the fertilizing power of putrid animal and vegetable substances was fully known, even in the remotest ages; but most speculists have hitherto attributed them to the oleaginous, mucilaginous, or saline particles then developed, forgetting that land is fertilized by *paring* and *burning*, though the oleaginous and mucilaginous particles are thereby consumed or reduced to a coal; and that the quality of mucilage, oil, or salt, in fertile land is so small that it could not contribute the thousandth part of the weight of any vegetable; whereas coal is supplied not only by the land, but also by the fixed air combine

combined with the earth, and also by that which is constantly set loose by various processes, and soon precipitates by the superiority of its specific gravity, and is then condensed in or mechanically absorbed by soils, or contained in dew. Lands, which contain iron in a semicalcined state, are thereby enabled to decompose fixed air; the iron, by the help of water, gradually attracting the pure air which enters into the composition of fixed air, as Mr Gadolin has shown; a discovery which appears to me among the most important of these later times; but these calces of iron may again be restored to their former state by union with oleaginous substances, as Mr Beaume has noticed; and this is one of the benefits resulting from the application of dung before it has fully putrefied. Hence we may understand how soils become effete and exhausted; this effect arising, in great measure, from the gradual loss of the carbonic principle deposited by vegetable and animal manures, and from their passing into the growing vegetables; and also from the loss of the fixed air contained in the argillaceous part of the soil which is decomposed by vegetables, and from the calcination of the ferruginous particles contained in the soil." Manures.

Concerning earths, Mr Kirwan observes, that minute portions of these are found in trees, and somewhat larger portions in culmiferous plants, into which they can only enter when dissolved or suspended in water. Minute portions of salts are also found in vegetables. On the whole, with regard to manuring or fertilizing a soil, Mr Kirwan considers the great question to be "how to render charcoal soluble in water for the purposes of vegetation." And to discover that composition of the different earths, best suited to detain or exhale the due proportion Earths and salts.

Mammres. proportion of the average quantity of moisture that falls in each particular country."

**Mixtures of
earths to
improve a
soil.**

**Mixtures
for clay
soils.**

Upon the first of these points Mr Kirwan suggests nothing very particular. He observes, that dung is a proper ingredient in the improvement of all sorts of soils; apprehending, no doubt, that its fermentation is the best mode yet discovered of rendering charcoal soluble in water for the purpose of vegetation. He is chiefly anxious about pointing out the proper kinds of

earths or mixtures of earths which ought to be applied to particular soils for their amelioration. With this view he explains minutely the way in which chemists may analyze the constituent parts of a soil. He remarks, that "the best manure for clayey soils is marl: in this all the books of agriculture are unanimous, and of the different sorts of marl, that which is most calcareous is best; the siliceous next best; limestone gravel best of all; and argillaceous marl least advantageous."

"Clayey soils are defective both in constitution and in texture: they want the calcareous ingredient and coarse sand. Calcareous marl supplies the calcareous ingredient chiefly; limestone gravel both. The other marls supply them in a lesser degree.

"A mixture of marl and dung is still more advantageous, because the dung supplies the carbonaceous ingredient. But the marl must be used in the same quantity as if dung had not been applied, otherwise the operation must be more frequently repeated.

"If marl cannot be had, a mixture of coarse sand and lime perfectly effete or extinguished, or chalk, will answer the same purpose, as it will supply the defective ingredient, and open the texture of the clay-

So also sand alone, or chalk, or powdered limestone, ^{Manures.} may answer, though less advantageously. Lime alone appears to me less proper, as it is apt to cake, and does not sufficiently open the soil.

“When these manures cannot be had, coal-ashes, chips of wood, burnt clay, brick-dust, gravel, or even pebbles, are useful; for all these improve the texture, and the former supply also the carbonaceous ingredient.”

A soil consisting of clayey loam “is defective either in the calcareous ingredient, or in the sandy, or in both; if in the first, the proper manure is chalk; if in the second, sand; if in both, siliceous marl or limestone gravel, or effete lime and sand.”

The chalky soil “wants both the argillaceous and the ^{Mixtures} stony, sandy, or gravelly, ingredients; therefore the ^{for a chalky} ~~the~~ soil. best manure for it is clayey loam or sandy loam; but when the chalk is so hard, as it frequently is in England, and so difficultly reducible to impalpable powder, as to keep of itself the soil sufficiently open, then clay is the best manure, as in such cases the coarse sand or gravelly ingredients of loam are of no use. Some think, it is true, that pebbles in a field serve to preserve or communicate heat; this use, however, is not sufficiently ascertained.

“The best manure for *chalky-loam* is clay, or argillaceous marl if clay cannot be had, because this soil is defective principally in the argillaceous ingredient.

“For sandy soils the proper manure is calcareous ^{Mixtures} marl. “In Norfolk they seem to value clay more ^{for sandy} ~~than~~ ^{soils.} marl, probably because their sandy soils already contain calcareous parts; possibly also they misname marl, calling mere chalk by that name. Lime or
chalk

Manures. chalk are less proper, as they do not give sufficient coherence to the soil; however, when mixed with earth or dung, they answer well, because they form a sort of marl or compound, comprehending the defective ingredients.

“ For sandy loams, chalk is recommended to be followed by clay; for till or vitriolic soils, lime or limestone gravel, or calcareous marl; for bogs or boggy soils, paring and burning, or lime are approved of; for heathy soils the same remedies are recommended. Gypsum is also considered as answering well for heathy soils when dry. Mr Kirwan observes, that the principal advantages arising from paring and burning are two: “ First, that it converts vegetables and their roots into coal. Hence it is, that agricultural writers tell us, though without knowing the reason, that all violence of fire is to be avoided, and that a slow smothering fire is best.

Theoretical
advantage
of paring
and burn-
ing.

“ Secondly, that it destroys the old sickly roots; and thus leaves room for others younger and more vigorous. But unless fresh seeds be sown, the soil will be unproductive for a number of years, and the coaly principle is apt to be rashly exhausted by an unskilful husbandman taking repeated white crops in succession.”

SECT.

SECT. VIII.

PRINCIPLES AND OPERATIONS OF THE DRILL OR HORSE-HOEING HUSBANDRY.

THE general properties attributed to the hoeing or drill husbandry may be reduced to two, viz. the promoting the growth of plants by hoeing, and the saving of seed; both of which are equally profitable to the farmer.

The advantages of tillage before sowing have already been pointed out. In this place we must confine ourselves to the utility of tillage after sowing. This kind of tillage is most generally known by the name of *horse-hoeing*. Advantages ascribed to horse-hoeing.

Land sowed with wheat, however well it may be cultivated in autumn, sinks in the winter; the particles get nearer together, and the weeds rise; so that in spring, the land is nearly in the same situation as if it never had been ploughed. This, however, is the season when it should branch and grow with most vigour, and consequently stands most in need of ploughing or hoeing, to destroy the weeds, to supply the roots with fresh earth, and, by dividing anew the particles of the soil, to allow the roots to extend and collect nourishment.

It is well known, that, in gardens, plants grow with double vigour after being hoed or transplanted. If plants growing in arable land could be managed with ease

Drill Husbandry. ease and safety in this manner, it is natural to expect, that their growth would be promoted accordingly. Experience shows, that this is not only practicable, but sometimes attended with many advantages.

In the operation of hoeing wheat, though some of the roots be moved or broken, the plants receive no injury; for this very circumstance makes them send forth a greater number of roots than formerly, which enlarge their pasture, and consequently augment their growth.

Sickly wheat has often recovered its vigour after a good hoeing, especially when performed in weather not very hot or dry.

Wheat, and such grain as is sown before winter, requires hoeing more than oats, barley, or other grain sown in the spring; for, if the land has been well ploughed before the sowing of spring corn, it neither has time to harden, nor to produce many weeds, not having been exposed to the winter's snow and rain.

Of Sowing.

Method of sowing in the drill husbandry.

As in the practice of this new husbandry, plants grow with greater vigour than by the old method, the land should be sowed thinner. It is this principle of the hoeing husbandry that has been chiefly objected to; for, upon observing the land occupied by a small number of plants, people are apt to look upon all the vacant space as lost. But this prejudice will soon be removed, when it is considered, that in the best land cultivated in the common method, and sown very thick, each feed produces but one or two ears; that, in the same land sown thinner, every feed produces two or three ears;

ears; and that a single seed sometimes produces 18 or 20 ears. Drill Husbandry.

In the common method, as there are many more plants than can find sufficient nourishment, and as it is impossible to assist them by hoeing, numbers die before they attain maturity; the greatest part remain sickly and drooping; and thus part of the seed is lost. On the contrary, in the new method, all the plants have as much food as they require; and as they are, from time to time, assisted by hoeing, they become so vigorous as to equal in their production the numerous but sickly plants cultivated in the common method.

Of Hoeing.

The new husbandry is absolutely impracticable in lands that are not easily ploughed. Attempting to cultivate land according to this husbandry, without attending to this circumstance, that it is practicable in no land excepting such as has already been brought into good tilth by the old method, has gone far to make it contemptible in many places.

When a field is in good tilth, it should be sown so thin as to leave sufficient room for the plants to extend their roots. After being well ploughed and harrowed, it must be divided into rows, at the distance of thirty inches from one another. On the sides of each of these rows, two rows of wheat must be sowed six inches distant from each other. By these means there will be an interval of two feet wide betwixt the rows, and every plant will have room enough to extend its roots, and to supply it with food. The intervals will likewise be sufficient for allowing the earth to be hoed or tilled without injuring the plants in the rows.

The

Drill Husbandry.

The different hoeings.

The first hoeing, which should be given before the winter, is intended to drain away the wet, and to dispose the earth to be mellowed by the frosts. These two ends will be answered by drawing two small furrows at a little distance from the rows, and throwing the earth taken from the furrows into the middle of the intervals. This first hoeing should be given when the wheat is in leaf.

The second hoeing, which is intended to make the plants branch, should be given after the hard frosts are over. To do this with advantage, after stirring the earth a little near the rows, the earth which was thrown into the middle of the intervals should be turned back into the furrows. This earth, having been mellowed by the winter, supplies the plants with excellent food, and makes the roots extend.

The third hoeing, which is intended to invigorate the stalk, should be given when the ears of the corn begin to show themselves. This hoeing may, however, be very slight.

But the last hoeing is of the greatest importance, as it enlarges the grain, and makes the ears fill at their extremities. This hoeing should be given when the wheat is in bloom; a furrow must be drawn in the middle of the interval, and the earth thrown to the right and left on the foot of the plants. This supports the plants, prevents them from being laid, and prepares the ground for the next sowing, as the seed is then to be put in the middle of the ground that formed the intervals.

The best season for hoeing is two or three days after rain, or so soon after rain as the soil will quit the instrument in hoeing. Light dry soils may be hoed almost

most at any time, but this is far from being the case with strong clay soils; the season for hoeing such is frequently short and precarious; every opportunity therefore should be carefully watched, and eagerly embraced. The two extremes of wet and dry, are great enemies to vegetation in strong clay soils. There is a period between the time of clay soils running together, so as to puddle by superfluous wet, and the time of their caking by drought, in which they are perfectly manageable. This is the juncture for hoeing; and so much land as shall be thus seasonably hoed, will not cake or crust upon the surface, as it otherwise would have done, till it has been soaked or drenched again with rain; in which case the hoeing is to be repeated as soon as the soil will quit the instrument, and as often as necessary; by which time the growing crop will begin to cover the ground, so as to act as a screen to the surface of the land against the intense heat of the sun, and thereby prevent, in a great measure, the bad effects of the soil's caking in dry weather.

Drill Husbandry.

By this successive tillage, or hoeing, good crops will be obtained, provided the weather is not very unfavourable.

But as strong vigorous plants are long before they arrive at maturity, corn raised in the new way is later in ripening than any other, and must therefore be sown earlier.

In order to prepare the intervals for sowing again, some well-rotted dung may be laid in the deep furrows made in the middle of the intervals; and this dung must be covered with the earth that was before thrown towards the rows of wheat. But, if the land does not require mending, the deep furrow is filled without any

Drill Husbandry. This operation should be performed immediately after harvest, that there may be time to give the land a slight stirring before the rows are sowed; which should occupy the middle of the space which formed the intervals during the last crop. The intervals of the second year take up the space occupied by the stubble of the first.

Supposing dung to be necessary, which is denied by many, a very small quantity is sufficient; a single layer, put in the bottom of each furrow, will be enough.

Description of the Instruments commonly used in the New Husbandry.

Instruments described Plate X. Fig. 3. is a marking plough. The principal use of this plough is to straighten and regulate the ridges. The first line is traced by the eye, by means of three poles, placed in a straight line. The plough draws the first furrow in the direction of this line; and at the same time, with the tooth A, fixed in the block of wood near the end of the cross-pole or slider BB, marks the breadth of the ridge at the distance intended. The ploughman next traces the second line or rutt made by the tooth, and draws a small furrow along it; and continues in this manner till the whole field is laid out in straight and equidistant ridges.

Breaking-up plough Fig. 4. is a plough for breaking up ley, or turning up the bottom of land when greatly exhausted. By its construction, the width and depth of the furrows can be regulated to a greater certainty than by any other hitherto known in this country. Its appearance is heavy: but two horses are sufficient to plough with it in ordinary free land; and only four are necessary in the

the stiffest clay-soils. This plough is likewise easily held and tempered. A, is the sword fixed in the fizers B, which runs through a mortise E, at the end of the beam C, and regulates the depth of the furrow by raising or depressing the beam; it is fixed by putting the pin D through the beam and sword, and is moveable at E. Drill Husbandry.

Fig. 1. is a jointed brake-harrow with 24 teeth, shaped like coulter, and standing at about an angle of 80 degrees. By this instrument the land is finely pulverized, and prepared for receiving the seed from the drill. It requires four horses in stiff, and two in open land. This harrow is likewise used for leveling the ridges; which is done by pressing it down by the handles where the ridge is high, and raising it up when low. Plate X.
Jointed harrow.

Fig. 2. is an angular weeding harrow, which may follow the brake when necessary. The seven hindmost teeth should stand at a more acute angle than the rest, in order to collect the weeds, which the holder can drop at pleasure, by raising the hinder part, which is fixed to the body of the harrow by two joints. Weeding harrow.

Fig. 3. is a pair of harrows with shafts. This harrow is used for covering the seed in the drills, the horse going in the furrow. Harrow with shafts.

Fig. 1. is a drill-plough, constructed in such a manner as to sow at once two rows of beans, pease, or wheat. This machine is easily wrought by two horses. A, is the happer for containing the seed; B, circular boxes for receiving the seed from the happer; CC, two square boxes which receive the seed from small holes in the circular boxes, as they turn round; and last of all, Plate VII.
Drill-plough.

Drill Huf-
bandry.

the seed is dropped into the drills through holes in the square boxes, behind the coulter D. The cylinder E follows, which, together with the wheel F, regulates the depth of the coulters, and covers the seed; the harrow G comes behind all, and covers the seed more completely. HH, two sliders, which, when drawn out, prevent the seed from falling into the boxes; and, I, is a ketch which holds the rungs, and prevents the boxes from turning, and losing seed at the ends of the ridges.

Plate X.
Single hoc-
plough.

Fig. 4. is a single hoc-plough of a very simple construction, by which the earth in the intervals is stirred and laid up on both sides to the roots of the plants, and at the same time the weeds are destroyed. AA the mouldboards, which may be raised or depressed at pleasure, according as the farmer wants to throw the earth higher or lower upon the roots.

Plate V.
Drill-rake.

Fig. 2. is a drill-rake for pease. This instrument, which is chiefly calculated for small inclosures of light grounds, is a sort of strong plough-rake, with four large teeth at *a, a, b, b*, a little incurvated. The distance from *a* to *a*, and from *b* to *b*, is nine inches. The interval between the two inner teeth, *a* and *b*, is three feet six inches, which allows sufficient room for the hoe-plough to move in. To the piece of timber *c c*, forming the head of the rake, are fixed the handles *d*, and the beam *e* to which the horse is fastened. When this instrument is drawn over a piece of land made thoroughly fine, and the man who holds it bears upon the handles, four furrows, *f, g, h, i*, will be formed, at the distance determined by the construction of the instrument. These distances may be accurately preserved, provided that the teeth *a a* return when the plough-
man

man comes back, after having ploughed one turn, in two of the channels formed before, marked *b b*: thus Drill Husbandry. all the furrows in the field will be traced with the same regularity. When the ground is thus formed into drills, the pease may be scattered by a single motion of the hand at a certain distance from one another into the channels, and then covered with the flat part of a hand-rake, and pressed down gently. This instrument is so simple, that any workman may easily make or repair it.

On Plate XIII. fig. 1. is delineated a patent drill machine, some time ago invented by the Reverend James Cooke of Heaton-Nouris near Manchester. Cooke's drill-machine. A, the upper part of the feed-box. B, the lower part of the same box. C, a moveable partition, with a lever, to which the grain or seed is let fall at pleasure from the upper to the lower part of the feed-box, from whence it is taken up by cups or ladles applied to the cylinder D, and dropped into the funnel E, and conveyed thereby into the furrow or drill made in the land by the coulter F, and covered by the rake or harrow G. H, a lever, by which the wheel I is lifted out of gear with the wheel K, to prevent the grain or seed being scattered upon the ground, while the machine is turning round at the end of the land, by which the harrow G is also lifted from the ground at the same time, and by the same motion, by means of the crank, and the horizontal lever *b, b*. L, a sliding lever, with a weight upon it, by means of which the depth of the furrows or drills, and consequently the depth that the grain or seed will be deposited in the land, may be easily ascertained. M, a screw in the coulter beam, by turning of which the feed-box B

Drill Huf-
bandry. } is elevated or depressed, in order to prevent the grain
or feed being crushed or bruised by the revolution of
Plate XIII the cups or ladles. Fig. 2. a rake with iron teeth,
to be applied to the under side of the rails of the ma-
chine, with staples and screw-nuts at " " , by which
many useful purposes are answered, viz. in accumula-
ting cutch or hay into rows, and as a scarificator for
young crops of wheat in the spring, or to be used upon
a fallow; in which case, the feed-box, the ladle cylin-
der, the coulters, the funnels, and harrows, are all ta-
ken away.

This side-view of the machine is represented, for the
sake of perspicuity, with one feed-box only, one coul-
ter, one funnel, one harrow, &c. whereas a complete
machine is furnished with five coulters, five harrows,
seven funnels, a feed-box in eight partitions, &c. with
ladles of different sizes, for different sorts of grain and
seeds.

These machines (with five coulters, sixteen guineas,
with four coulters, fifteen guineas), equally excel in set-
ting or planting all sorts of grain and seeds, even carrot-
seed, to exactness, after the rate of from eight to ten
chain acres per day, with one man, a boy, and two
horses. They deposite the grain or feed in any given
quantity from one peck to three bushels per acre, re-
gularly and uniformly, and that without grinding or
bruising the seed, and at any given depth, from half an
inch to half a dozen inches, in rows at the distance of
twelve, sixteen and twenty-four inches, or any other
distance. They are equally useful on all lands, ar-
durable, easy to manage, and by no means subject to be
put out of repair.

The ladle cylinder D is furnished with cups or la-
dles

Ladles of four different sizes for different sorts of grain or feeds, which may be distinguished by the numbers 1, 2, 3, 4.—N^o 1. (the smallest size) is calculated for turnip-feed, clover-feed, cole-feed, rape, &c. and will sow something more than one pound per statute acre. N^o 2. for wheat, rye, hemp, flax, &c. and will sow something more than one bushel per acre. N^o 3. for barley; and will sow one bushel and a half per acre. N^o 4. for beans, oats, pease, vetches, &c. and will sow two bushels per acre.

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Notwithstanding the above specified quantities of grain or feeds, a greater or less quantity of each may be sown at pleasure, by stopping up with a little clay, or by adding a few ladles to each respective box. The grain or feeds intended to be sown, must be put in those boxes, to which the cups or ladles as above described respectively belong, an equal quantity into each box, and all the other boxes empty. The ladle cylinder may be reversed, or turned end for end at pleasure, for different sorts of grain, &c.

For sowing beans, oats, pease, &c. with a five-coulter machine, four large ladles must occasionally be applied at equal distances round those parts of the cylinder which subtend the two end boxes. And for sowing barley, eight large ones must be applied as above; or four ladles, N^o 2. to each of the wheat boxes. These additional ladles are fixed on the cylinder with nails, or taken off in a few minutes; but for sowing with a four-coulter machine, the above alterations are not necessary.

The funnels are applied to their respective places by corresponding numbers. Care should be taken, that the points of the funnels stand directly behind the backs of

Drill Huf-
bandry.

the coulter, which is done by wedges being applied to one side or other of the coulter, at the time they are fixed in their respective places.

The machine being thus put together, which is readily and expeditiously done, as no separate part will coincide with any other but that to which it respectively belongs, and an equal quantity of grain or seed in each of the respective boxes, the land also being previously ploughed and harrowed once or so in a place to level the surface; but if the land be very rough, a roller will best answer that purpose, whenever the land is dry enough to admit of it; and upon strong clays, a spiked roller is sometimes necessary to reduce the size of the large dry clods; which being done, the driver should walk down the furrow or edge of the land, and having hold of the last horse's head with his hand, he will readily keep him in such a direction, as will bring the outside coulters of the machine within three or four inches of the edge of the land or ridge, at which uniform extent he should keep his arm till he comes to the end of the land; where, having turned round, he must come to the other side of his horses, and walking upon the last outside drill, having hold of the horse's head with his hand, as before, he will readily keep the machine in such a direction, as will strike the succeeding drill at such a distance from the last outside one, or that he walks upon, as the coulter is distant from each other.

The person who attends the machine should put down the lever H soon enough at the end of the land, that the cups or ladles may have time to fill, before he begins to sow; and at the end of the land, he must apply his right hand to the middle of the rail between
the

the handles, by which he will keep the coulter in the ground, while he is lifting up the lever H with his left hand, to prevent the grain being scattered upon the headland, while the machine is turning round; this he will do with great ease, by continuing his right hand upon the rail between the handles, and applying his left arm under the left handle, in order to lift the coulter out of the ground while the machine is turning round.

Drill Hand-
bandry.

If there be any difficulty in using the machine, it consists in driving it straight. As to the person who attends the machine, he cannot possibly commit any errors, except such as are wilful, particularly as he sees, at one view, the whole process of the business, viz. that the coulters make the drills of a proper depth; that the funnels continue open to convey the grain or feed into the drills; that the rakes or harrows cover the grain sufficiently; and when feed is wanting in the lower boxes B, which he cannot avoid seeing, he readily supplies them from the upper boxes A, by applying his hand, as the machine goes along, to the lever C. The lower boxes B should not be suffered to become empty before they are supplied with feed, but should be kept nearly full, or within an inch or so of the edge of the box.

If chalk lines are made across the backs of the coulters, at such a distance from the ends as the feed should be deposited in the ground (viz. about two inches for wheat, and from two to three for spring corn,) the person that attends the machine will be better able to ascertain the depth the feed should be deposited in the drills, by observing, as the machine goes along, whether the chalk lines are above or below the surface
of

Drill Huf- of the land; if above, a proper weight must be ap-
bandry. plied to the lever, L, which will force the coulter
into the ground; if below, the lever L and weight
must be reversed, which will prevent their sinking too
deep.

In different parts of the kingdom, lands or ridges are of different sizes. Where the machine is too wide for the land, one or more funnels may occasionally be stopped with a little loose paper, and the seed received into such funnel returned at the end of the land, or sooner if required, into the upper feed-box. But for regularity and expedition, lands consisting of so many feet wide from outside to outside, as the machine contains coulters, when fixed at twelve inches distance, or twice or three times the number, &c. are best calculated for the machine. In wet soils or strong clays, lands or ridges of the width of the machine, and in dry soils, of twice the width, are recommended. For sowing of narrow high-ridged lands, the outside coulters should be let down, and the middle ones raised, so that the points of the coulters may form the same curve that the land or ridge forms. And the loose soil harrowed down into the furrows should be returned to the edges of the lands or ridges from whence it came, by a double mouldboard or other plough, whether the land be wet or dry.

Clover or other leys, intended to be sown by the machine, should be ploughed a deep strong furrow and well harrowed, in order to level the surface, and to get as much loose soil as possible for the coulters to work in; and when sown, if any of the seed appears in the drills uncovered by reason of the stiff texture of the soil, or toughness of the roots, a light harrow may
be

be taken over the land, once in a place, which will effectually cover the seed, without displacing it all in the drills. For sowing leys, a considerable weight must be applied to the lever L, to force the coulters into the ground; and a set of wrought-iron coulters, well steeled, and made sharp at the front edge and bottom, are recommended; they will pervade the soil more readily, consequently require less draught, and expedite business more than adequate to the additional expence.

For every half acre of land intended to be sown by the machine with the seed of that very valuable root, carrot, one bushel of saw-dust, and one pound of carrot-feed, should be provided; the saw-dust should be made dry, and sifted to take out all the lumps and chips, and divided into eight equal parts or heaps; the carrot-feed should likewise be dried, and well rubbed between the hands, to take off the beards, so that it may separate readily; and being divided into eight equal parts or heaps, one part of the carrot-feed must be well mixed with one part of the saw-dust, and so on, till all the parts of carrot-feed and saw-dust are well mixed and incorporated together; in which state it may be sown very regularly in drills at twelve inches distance, by the cups or ladles N^o 2. Carrot-feed resembling saw-dust very much in its size, roughness, weight, adhesion, &c. will remain mixed as above during the sowing; a ladleful of saw-dust will, upon an average, contain three or four carrot-seeds, by which means the carrot-feed cannot be otherwise than regular in the drills. In attempting to deposit small seeds near the surface, it may so happen that some of the seeds may not be covered with soil; in which case, a
light

Drill Husbandry. light roller may be drawn over the land after the seed is sown, which will not only cover the seeds, but will also, by levelling the surface, prepare the land for an earlier hoeing than could otherwise have taken place.

It has always been found troublesome, sometimes impracticable, to sow any kind of grain or seeds (even broad-cast) in a high wind. This inconvenience is entirely obviated by placing a screen of any kind of cloth, or a sack, supported by two uprights nailed to the sides of the machine, behind the funnels, which will prevent the grain or seed being blown out of its direction in falling from the ladles into the funnels. Small pipes of tin may also be put on to the ends of the funnels, to convey the grain or seed so near the surface of the land, that the highest wind shall not be able to interrupt its descent into the drills.

Respecting the use of the machine, it is frequently remarked by some people not conversant with the properties of matter and motion, that the soil will close after the coulters, before the seed is admitted into the drills. Whereas the very contrary is the case; for the velocity of the coulters in passing through the soil, is so much greater than the velocity with which the soil closes up the drills by its own spontaneous gravity, that the incisions or drills will be constantly open for three or four inches behind the coulters; by which means, it is morally impossible (if the points of the funnels stand directly behind the coulters) that the seed, with the velocity it acquires in falling through the funnels, shall not be admitted into the drills.

Plate VIII. Fig. 10. is a new constructed simple hand-hoe, by which one man will effectually hoe two chain acres per day,

may, earthing up the soil at the same time to the rows of corn or pulse, so as to cause roots to issue from the first joint of the stem, above the surface of the land, which otherwise would never have existed. Drill Husbandry.
Hand-hoe.

This hoe is worked much in the same manner as a common Dutch hoe, or scuffle, is worked in gardens. The handle is elevated or depressed, to suit the size of the person that works it, by means of an iron wedge being respectively applied to the upper or under side of the handle that goes into the socket of the hoe.

The wings or moulding plates of the hoe, which are calculated to earth up the soil to the rows of corn, so as to cause roots to issue from the first joint of the stem above the surface, which otherwise would not have existed, should never be used for the first hoeing, but should always be used for the last hoeing, and used or not used, at the option of the farmer, when any intermediate hoeing is performed.

Summary of the Operations necessary in executing the New Husbandry with the Plough.

1. It is indispensably necessary that the farmer be provided with a drill and hoe-plough. Summary of the operations.
2. The new husbandry may be begun either with the winter or spring corn.
3. The land must be prepared by four good ploughings, given at different times, from the beginning of April to the middle of September.
4. These ploughings must be done in dry weather, to prevent the earth from kneading.
5. The land must be harrowed in the same manner as if it were sowed in the common way.

6. The

Drill Husbandry.

6. The rows of wheat should be sowed very straight.

7. When the field is not very large, a line must be strained across it, by which a drill may be traced with a hoe for the horse that draws the drill to go in; and when the rows are sown, 50 inches must be left betwixt each drill. But, when the field is large, stakes at five feet distance from each other must be placed at the two ends. The workman must then trace a small furrow with a plough that has no mouldboard, for the horse to go in that draws the drill, directing himself with his eye by the stakes.

8. The sowing should be finished at the end of September, or beginning of October.

9. The furrows must be traced the long way of the land, that as little ground as possible may be lost in headlands.

10. The rows, if it can be done, should run down the slope of the land, that the water may get the ear off.

11. The seed-wheat must be plunged into a tub of lime-water, and stirred, that the light corn may come to the surface and be skimmed off.

12. The seed must next be spread on a floor, and frequently stirred, till it is dry enough to run through the valves of the happer of the drill.

13. To prevent smut, the seed may be put into a ley of ashes and lime.

14. Good old seed-wheat should be chosen in preference to new, as it is found by experience not to be so subject to smut.

15. After the happers of the drill are filled, the horse must go slowly along the furrow that was traced. That a proper quantity of seed may be sown, the aperture

erture of the happer must be suited to the size of the grain. Drill Hus-
bandry.

16. As the drill is seldom well managed at first, the field should be examined after the corn has come up, and the deficiencies be supplied.

17. Upon wet soils or strong clays, wheat should not be deposited more than two inches deep, on any account whatever; nor less than two inches deep on dry soils. From two to three inches is a medium depth for all spring corn. But the exact depth at which grain should be deposited in different soils, from the lightest sand to the strongest clay, is readily ascertained only by observing at what distance under the surface of the land, the secondary or coronal roots are formed in the spring.

18. Stiff lands, that retain the wet, must be stirred or hoed in October. This should be done by opening a furrow in the middle of the intervals, and afterwards filling it up by a furrow drawn on each side, which will raise the earth in the middle of the intervals, and leave two small furrows, next the rows, for draining off the water, which is very hurtful to wheat in winter.

19. The next stirring must be given about the end of March, with a light plough. In this stirring the furrows made to drain the rows must be filled up by earth from the middle of the interval.

20. Some time in May, the rows must be evened; which, though troublesome at first, soon becomes easy, as the weeds are soon kept under by tillage.

21. In June, just before the wheat is in bloom, another stirring must be given with the plough. A deep furrow

Drill Husbandry. furrow must be made in the middle of the intervals, and the earth thrown upon the sides of the rows.

22. When the wheat is ripe, particular care must be taken, in reaping it, to trample as little as possible on the ploughed land.

23. Soon after the wheat is carried off the field, the intervals must be turned up with the plough, to prepare them for the seed. The great furrow in the middle must not only be filled, but the earth raised as much as possible in the middle of the intervals.

24. In September, the land must be again sowed with a drill, as above directed.

25. In October, the stubble must be turned in for forming the new intervals; and the same management must be observed as directed in the first year.

To give an idea of the arguments by which the drill husbandry was originally supported, we shall here take notice of a comparative view of the old and new methods of culture which was furnished for the editors of Mr Tull's Horse-hoeing Husbandry, by a gentleman who for some years practised both in a country where the soil was light and chalky, like that from which he drew his observations. It is necessary to remark, that in the new husbandry every article is stated at its full value, and the crop of each year is four bushels short of the other; though, in several years experience, it has equalled and generally exceeded those in the neighbourhood in the old way.

An Estimate of the Expence and Profit of 10 Acres of Land in 20 Years. Drill Husbandry.

I. In the old way.

First year, for wheat, costs 33l.	L.	s.	d.	L.	s.	d.	Comparative view of the expence and profits of the old and new husbandry.
5s.; viz.							
First ploughing, at 6s. per acre	3	0	0				
Second and third ditto. at 8s.							
per acre -	4	0	0				
Manure, 30s. per acre	15	0	0				
	<hr/>			22	0	0	
Two harrowings, and fowing,							
at 2s. 6d. per acre.	1	5	0				
Seed, three bushels per acre, at							
4s. per bushel. -	6	0	0				
Weeding, at 2s. per acre,	1	0	0				
Reaping, binding, and carrying,							
at 6s. per acre -	3	0	0				
	<hr/>			11	5	0	
Second year, for barley, costs							
11l. 6s. 8d.; viz.							
Once ploughing at 6s. per acre	3	0	0				
Harrowing and fowing, at 1s. 6d.							
per acre -	0	15	0				
Weeding, at 1s. per acre	0	10	0				
Seed, four bushels per acre, at							
2s. per bushel -	4	0	0				
Cutting, raking, and carrying,							
at 3s. 2d. per acre -	1	11	8				
Grass-seeds, at 3s. per acre	1	10	0				
	<hr/>			11	6	8	
				44	11	8	
Vol. II.	S					Third	

Drill Huf-
bandry.

L. s. d.

Third and fourth years, lying in grafs, cost
nothing: so that the expence of ten
acres in four years comes to 44l. 11s. 8d.
and in twenty years to -

228 18 4

First year's produce is half a L. s. d.
load of wheat per acre, at 7l. 35 0 0

Second year's produce is two
quarters of barley per acre,

at 1l. - - 20 0 0

Third and fourth years grafs is

valued at 1l. 10s. per acre 15 0 0

So that the produce of ten acres in four years is 70 0 0

And in twenty years it will be 350 0 0

Deduct the expence, and there remains }
clear profit on ten acres in twenty } 127
years by the old way }

II. In the new way.

First year's extraordinary expence is, for
ploughing and manuring the land, the
same as in the old way, 22l.

Ploughing once more, at 4s. L. s. d.
per acre - - 2 0 0

Seed, nine gallons per acre,

at 4s. per bushel - 2 5 0

Drilling, at 7d. per acre - 0 5 10

Hand-hoeing and weeding, at

2s. 6d. per acre - 1 5 0

Carry over 5 15 10

	<i>L.</i>	<i>s.</i>	<i>d.</i>	<i>L.</i>	<i>s.</i>	<i>d.</i>	Drill Hus- bandry.
Brought over	5	15	10				
Horse-hoeing six times, at 10s. per acre - - -			5				
Reaping, binding, and carry- ing, at 6s. per acre - -			3				
The standing annual charge —							
on ten acres, is - - -	13	15	10				

Therefore the expence on ten acres in twenty years is - - -	275	16	8
Add the extraordinaries of the first year, ————			
and the sum is - - - -	297	16	8
The yearly produce is at least two quar- ters of wheat per acre, at 11. 8s. per quarter; which, on ten acres in twenty years, amounts to - - -	560	0	0
Therefore, all things paid, there remains clear profit on ten acres in twenty years ————			
by the new way - - - -	262	3	4

“ So that the profit on ten acres of land in twenty years, in the new way, exceeds that in the old by 135l. 1s. 8d. and consequently is considerably more than double thereof; an ample encouragement to practice a scheme whereby so great advantage will arise from so small a quantity of land, in the compass of a twenty-one years lease; one year being allowed, both in the old and new way, for preparing the ground.

“ It ought withal to be observed, that Mr Tull’s husbandry requires no manure at all, though we have here, to prevent objections, allowed the charge thereof

Drill hus-
bandry. for the first year; and moreover, that though the crop of wheat from the drill-plough is here put only at two quarters on an acre, yet Mr Tull himself, by actual experiment and measure, found the produce of his drilled wheat crop amounted to almost four quarters on an acre."

Expense
and profit. It appears also from a comparative calculation of expense and profit between the drill and common husbandry, taken from Mr Baker's report to the Dublin Society of his experiments in agriculture for the year 1765, that there is a clear profit arising upon an Irish acre of land in 15 years in the drill husbandry of 52l. 3s. 11d. and in the common husbandry of 27l. 19s. 2d. and therefore a greater profit in the drill acre in this time of 24l. 4s. 9d. which amounts to 1l. 12s. 3½d. *per annum*. From hence he infers, that in every 15 years the fee-simple of all the tillage-lands of the kingdom is lost to the community by the common course of tillage. In stating the accounts, from which their result is obtained, no notice is taken of fences, water-cutting the land, weeding and reaping, because these articles depend on a variety of circumstances, and will, in general, exceed in the common husbandry those incurred by the other.

Certainty of
a crop. Besides, the certainty of a crop is greater in this new way than in the old way of sowing; for most of the accidents attending wheat crops are owing to their being late sown, which is necessary to the farmer in the old way; but in the horse-hoeing method the farmer may plough two furrows whereon the next crop is to stand immediately after the first crop is off. In this manner of husbandry, the land may be ploughed dry and drilled wet, without any inconvenience; and
the

the seed is never planted under the furrow, but placed just at the depth which is most proper, that is, at about two inches; in which case it is easy to preserve it, and there is no danger of burying it. Thus the seed has all the advantage of early sowing, and none of the disadvantages that may attend it in the other way, and the crop is much more certain than by any other means that can be used.

Drill Husbandry.

The condition in which the land is left after the crop, is no less in favour of the horse-hoeing husbandry than all the other articles. The number of plants is the great principle of the exhausting of land. In the common husbandry, the number is vastly greater than in the drilling way, and three plants in four often come to nothing, after having exhausted the ground as much as profitable plants; and the weeds which live to the time of harvest in the common way, exhaust the land no less than so many plants of corn; often much more. The horse-hoeing method destroys all the weeds in the far greater part of the land, and leaves that part unexhausted and perfectly fresh for another crop. The wheat plants being also but a third part of the number at the utmost of those in the sowing way, the land is so much the less exhausted by them; and it is very evident from the whole, that it must be, as experience proves that it is, left in a much better condition after this than after the common husbandry.

Condition of the land.

The farmers who are against this method object, that it makes the plants too strong, and that they are more liable to the blacks or blights of insects for that reason; but as this allows that the hoeing can, without the use of dung, give too much nourishment, it is very plain that it can give enough; and it is the farmer's

Objections and answers.

Drill Husbandry. fault if he do not proportion his pains so as to have the advantage of the nourishment without the disadvantages. It is also objected, that as hoeing can make poor land rich enough to bear good crops of wheat, it may make good land too rich for it. But if this should happen, the sowing of wheat on it may be let alone a while, and in the place of it the farmer may have a crop of turnips, carrots, cabbages, and the like, which are excellent food for cattle, and cannot be over-nourished: or, if this is not chosen, the land, when thus made too rich, may soon be sufficiently impoverished by sowing corn upon it in the common old way.

The method of horse-hoeing husbandry, so strongly recommended by Mr Tull, is objected to by many on account of the largeness of the intervals which are to be left between the rows of corn. These are required to be about five feet wide; and it is thought that such wide spaces are so much lost earth, and that the crop is to be so much the less for it. But it is to be observed, that the rows of corn separated by these intervals need not be single; they may be double, triple, or quadruple, at the pleasure of the farmer; and four rows thus standing as one will have the five feet interval but one-fourth of its bigness, as to the whole quantity, and it will be but as fifteen-inch intervals to plant in single rows. Corn that is sown irregularly in the common way, seems indeed to cover the ground better than that in rows; but this is a mere *deceptio visus*; for the stalks of corn are never so thick as when they come out of one plant, or as when they stand in a row; and a horse-hoed plant of corn will have 20 or 30 stalks in a piece of ground of the same quantity, where an unhoeed plant will have only two or three stalks.

If

If these stalks of the hoed plant were separated and planted over the intervals, the whole land would be better covered than it is in the common way; and the truth is, that though these hoed fields seem to contain a much less crop than the common sown fields, yet they in reality do contain a much greater. It is only the different placing that makes the sown crop seem the larger, and even this is only while both crops are young.

Drill Husbandry.

- * The intervals are not lost ground, as is usually supposed, but when well horse-hoed they are all employed in the nourishment of the crop; the roots of the plants in the adjoining rows spreading themselves through the whole interval, and drawing such nourishment from it, that they increase accordingly. When the plants stand in the scattered way, as in common sowing, they are too close to one another; each robs its neighbours of part of their nourishment, and consequently the earth is soon exhausted, and all the plants half starved. The close standing of them also prevents the benefit of after-tilling, as the hoe cannot be brought in, nor the ground by any means stirred between them to give it a new breaking, and consequently afford them new food.

Experiments have abundantly proved, that in large grounds of wheat where the different methods have been tried, those parts where the intervals were largest have produced the greatest crops, and those where hoeing was used without dung have been much richer than those where dung was used without hoeing. If it were possible that plants could stand as thick, and thrive as well over the whole surface of the ground as they do in the rows separated by these large intervals, the

Drill Hus-
bandry. crops of corn produced would be vastly greater than any that have been heard of; but the truth is, that plants receive their growth not according to the ground they stand on, but to the ground they can extend their roots into; and therefore a single row may contain more plants than a large interval can nourish, and therefore the same number that stands in that row, and no more than these, could be nourished, if scattered over the whole interval: and they would be much worse nourished in that way; because while the interval is void, the earth may be stirred about them, and new roots will be formed in great numbers from every one broken by the instruments, and new nourishment laid before these roots by the breaking the particles of earth, by which the plants will have supplies that they cannot have when scattered over the whole surface, because the ground is then all occupied, and cannot be moved between the plants.

In what
situations
the new
method is
less proper.

All soils and all situations are not equally proper for this method of planting in rows, with large intervals and hoeing between. The lightest soils seem to be best for it, and the tough and wet clays the worst. Such grounds as lie on the sides of hills are also less proper than others for this work.

This method is not so proper in common fields, but that not in respect of the soil, but of the husbandry of the owners, who are usually in the old way, and change the species of corn, and make it necessary to fallow every second, third, or fourth year. Nevertheless it has been found by later experiments, that the intervals betwixt the rows of plants, as recommended by Mr Tull, were too great, perhaps double of what they should be in the most profitable method of culture; by which means
much

much less crops are obtained than might be produced at nearly the same expence. This has rendered the profits of the drill method much less than they would have been in a more judicious practice, and, consequently, has proved a great disadvantage to it in comparison with the broad-cast. Mr Tull was led into this, partly from the want of more perfect instruments for hoeing, and of ploughs proper for drilling. Drill Husbandry.

To the preceding statements, the following observations by Sir John Anstruther, published among the Select Papers of the Bath Society, may not be improperly subjoined.

The slow progress which the drill-husbandry has made in many parts of Great Britain since Mr Tull's time, he observes, has been principally owing to the want of proper drill-ploughs. Before drilling can become general, those ploughs must be simple, such as a common ploughman, accustomed to use strong instruments, can use without breaking, and such also as common workmen can easily make or repair. Mathematical accuracy he considers as not required for delivering the seed: for it matters very little whether there be a quarter of a peck more or less sown, if it be delivered with tolerable regularity. He therefore had a plough made, according to his own directions, by a common plough-wright, of sufficient strength for any land made fit for turnips or wheat. It was tried on very rough ground unfit for sowing, in order to ascertain its strength; and it had been used for eight years without its needing any repair. It is a double drill-plough, which sows two ridges at a time, the horse going in the furrow between them, and of course does not tread upon the ground intended to be sown; which
with

Observations by Sir John Anstruther.

Drill Husbandry. with a single drill must be the case, and does much harm by the horses feet sinking and making holes in the fine ground, which retain the water, and hurt the wheat when young.

He proceeds to observe, "That having read Mr Forbes upon the extensive practice of the new husbandry, and some other authors, who gave a more clear and distinct account of the different operations in drilling than had heretofore been given, I wished to try them, and to adapt my plough to sow the quantities therein directed. It was, however, adjusted to sow a smaller quantity, and the seed was not steeped.

"Not having ground so proper as I wished, it was drilled on the side of a field, the soil of which was light and sandy, and in such bad order, that the preceding crop was a very indifferent one. It was therefore manured with a compost-dunghill.

"After cross-ploughing and manuring, it was laid into four and a half feet ridges, then harrowed and drilled with one peck and a half of wheat on an acre and a quarter, which is nearly one peck and a fifth per English acre. It was drilled the 27th of October, and rolled after drilling. The crop was late in its appearance, and very backward in the spring.

"March 31st, it was horse-hoed one furrow *from* the rows.

"April 8th, it was hand-hoed and weeded in the rows.

"April 25th, horse-hoed again, laying a furrow back to the rows.

"May 15th, hand-hoed the second time.

"June 2d, horse-hoed *from* the rows.

"June

“ June 12th, hand-hoed the third time.

“ July 14th, horse-hoed *to* the rows.

Drill Husbandry.

“ At this last hoeing, as many of the ears were beaten down into the intervals by wind and rain, a man went before the horse-hoe, and turned the ears back into their proper place.

“ The crop, when reaped and thrashed, yielded me 36 bushels on one acre and a quarter, which is 28 bushels and three pecks per acre; and the produce from one peck and half 96 for one.

“ As the produce appeared so great, from land in such bad order, it was carefully measured again, and found to be right. But this increase, though great, was not so large as Mr Craick of Glasgow had without dung.

“ Mr Randal says, ‘ It is an experimental fact, that on a fine loam exquisitely prepared, 144 bushels have been produced from one acre. And, I believe, it is not known what the increase may be brought to in rich lands by high cultivation.’

“ Some years since, I had beans dropt alternately with potatoes, at two feet distance in the rows, which were three feet apart, and ploughed in the intervals. The land adjoining was sown with beans and pease, which were a good crop; but those sown among the potatoes a better one. I pulled one stem of the beans planted with the potatoes, which had three branches rising from the bottom, and it produced 225 beans. In all the trials of drilled beans, most of the stems had two branches, with many pods upon each.—From these and other instances, I believe it is not yet known to what increase grain may be brought by drilling, good cultivation, and manure.

“ Horse-

Drill Husbandry.

“ Horse-hoeing is certainly preferable to close drilling or hand-hoeing ; but the latter is superior to broad-cast.

“ Horse-hoeing the full depth increases the crop, by making it tiller or branch more than it otherwise would do ; and the advantage is distinctly observable every hoeing by the colour of the grain. It prepares the ground for the next crop, at the same time that it increases the crop growing, which hand-hoeing does not, although it may destroy the weeds. Thus drilled ground is kept in a loose open state to receive the benefit of the influence of the air and weather, which broad-cast has not ; and it is evident, from certain experience, that crops may be drilled many years to good advantage without manure.

“ Suppose the crops only 20 bushels per acre, what course of broad-cast crops will give 5l. an acre for the course ? But suppose they are dunged the same as any ground in the most approved course, there is the greatest reason to expect as much as in the above experiment, which is 28 $\frac{1}{2}$, and at 5s. per bushel amounts to 7l. 3s. 9d.

“ Calculations may be of service to those who wish to try drilling, and have few books to direct them.

“ One acre is 10 chains long, of 660 feet, or 220 yards long, and one yard broad, containing 4840 square yards. Then if the ridge is four feet six inches, this makes 24 ridges, and three feet to spare. This length of 220 yards multiplied by 14 (the number of ridges), gives a length of yards 3080, to which add 146 for the spare three feet, and it will be 3226 yards. And as two rows are drilled on a ridge, the number of rows will be in length 6452 yards ; but as a deduction

tion of 172 yards must be made for the head-ridges, supposed three yards each, &c. the whole length to be sown will be 6280 yards clear. Now a gallon (Winchester) holds about 80,000 grains. The quantity recommended to be drilled by Mr Forbes and others, being six gallons, or two-thirds of a bushel per acre, is nearly 78 grains to a yard, or 26 to a foot. But in my experiment, by this calculation, it was only about 11 grains to a foot: which is quite sufficient, if the seed be good, and it be not destroyed by vermine.

Drill Husbandry.

“ Now with regard to the quantity of land this drill-plough may sow; if a horse walks at the rate of two miles per hour, he goes 16 miles in eight hours, or 28,460 yards. As he sows two ridges at once, this is seven lengths and two-thirds per acre, or 1686 yards to sow an acre, being nearly 17 acres in a day.

“ Four horse-hoeings are calculated equal to two ploughings. In plain ploughing they suppose the ridge is ploughed with four furrows, or eight for twice ploughing. The four horse-hoeings are eight furrows, equal to two ploughings.

“ Mr Tull directs four hoeings, and Mr Forbes five. 1st, In November, when the plant has four blades. 2dly, In March, deep, and nearer the rows than the former. Both these hoeings should be *from* the rows. 3dly, Hand-hoed when it begins to spindle, if the earth be crumbly, *to* the rows. 4thly, When it begins to blossom, *from* the rows, but as near to them as in the second hoeing. 5thly, When done blossoming, to ripen and and fill the grain, *to* the rows.

“ The last hoeing Mr Tull does not direct, but Mr Forbes advises it, as being of essential service in filling the grain, and saving trouble in making the next seed-furrows

Drill Husbandry furrows. They advise the patent or sowing-plough for hoeing; and the expence is calculated by Mr Craick at one guinea per acre, reaping included.

“ But let us suppose the following, which are the prices in the county I live in (Fife.)

		L.	s.	d.
Ploughing to form the ridges,	-	0	4	0
Harrowing,	-	0	0	4
Four hoeings, equal to two ploughings,		0	8	0
Sowing,	-	0	0	4
Hand-hoeing twice,	-	0	8	0
Seed, one peck and a half, at 5s. a bushel,		0	1	10

Whole expence per acre, 1 2 6”

The drill and the broad-cast methods more particularly compared.

Drill-husbandry is, as a good writer has justly defined it, “ *the practice of a garden brought into the field.*”

Every man of the least reflection must be sensible, that the practice of the garden is much *better* than that of the field, only a little more expensive; but if (as is alleged) this extra expence be generally much more than repaid by the superior goodness and value of drilled crops, it ought to have no weight in comparing the two modes of husbandry.

In the broad-cast method the land is often sown in bad tilth, and always scattered at random, sometimes by very unskilful hands. In drilling, the land must be in fine order; the seed is set in trenches drawn regularly, all of nearly an equal depth, and that depth suited to the nature of each kind of seed. These seeds are also distributed at proper distances, and by being equally and speedily covered, are protected from vermine, and other injuries;

injuries; so that the practice of the garden is here exactly introduced into the field.

Drill Husbandry.

In the broad-cast method the seed falls in some places too thick, in others too thin; and being imperfectly covered, a part of it is devoured by vermine which follow the sower; another part is left exposed to rain or frost, or to heats, which greatly injure it. When harrowed, a great part of it (small seeds especially) is buried so deep, that if the soil be wet, it perishes before it can vegetate.

Again: When thus sown, there is no meddling with the crop afterwards, because its growth is irregular. The soil cannot be broken, to give it more nourishment, nor can even the weeds be destroyed without much inconvenience and injury.

But in the drill-husbandry the intervals between the rows, whether double or single, may be horse-hoed; and thereby nourishment may repeatedly be given to the plants, and the weeds almost totally destroyed.

The very same effects which digging has upon young shrubs and trees in a garden, will result from horse-hoeing in a field, whether the crop be corn or pulse: For the reason of the thing is the same in both cases, and being founded in nature and fact, cannot ever fail. In drilling, no more plants are raised on the soil than it can well support; and by dividing and breaking the ground they have the full advantage of all its fertility.

The plough prepares the land for a crop, but goes no further; for, in the broad-cast husbandry, it cannot be used: but the crop receives greater benefit from the tillage of the land by the horse-hoe, while it is growing, than it could in the preparation. No care in tilling the land

Drill Husbandry.

land previous to sowing can prevent weeds rising with the crop; and if these weeds be not destroyed while the crop is growing, they will greatly injure it. In the broad-cast husbandry this cannot be done; but in drilling, the horse-hoe will effect it easily.

And what adds to the farmer's misfortune is, that the most pernicious weeds have seeds winged with down, which are carried by the wind to great distances; such as thistles, sow-thistles, colts-foot, and some others.

If the expence of horse-hoeing be objected, there are two answers which may very properly be made: The first is, that this expence is much less than that of hand-hoeing, were it practicable, or of hand-weeding. The second is, that it is more than repaid by the quantity of seed saved by drilling; to say nothing of the extra quantity and goodness of the crops, which are generally self-evident.

Remarks on the above statements.

UPON the whole, we have accounted it necessary to state the nature of the drill or horse-hoeing husbandry, together with the arguments in support of it, and this chiefly for two reasons: First, because it still has a considerable number of very respectable agriculturists in different parts of the island who adhere to it; and, secondly, because the art itself was undoubtedly at one period greatly indebted to it. It was of great use in exciting suspicions concerning the correctness of the old modes of cultivation, and in directing the views both of philosophers and of farmers towards improvement in general. It is to be observed, however, that a part of the celebrity of the horse-hoeing husbandry undoubtedly arises from comparing it with the defective modes of cultivation which ordinarily prevailed at the time of its

its introduction ; but since the discovery of the value of ^{Drill Husbandry.} turnips and clover, as preparations for barley and wheat, the character of the broad-cast husbandry has greatly altered. In consequence of an endless variety of trials, by skilful and unprejudiced men, the horse-hoeing method is not absolutely rejected, though it is restricted in its application. With regard to white crops, it seems ~~upon~~ the whole justly to be disregarded ; though it is retained for potatoes, cabbages, and beans, and frequently also turnips. With regard to these, it possesses this great advantage, that it becomes a most valuable substitute for the expensive requisite of a summer fallow, which would otherwise be necessary to clean and pulverize the soil.

It may be proper here to remark, however, that the drill husbandry is by no means a modern European invention. In China it is universally practised. It is ^{The drill husbandry not a modern discovery.} now used in the Carnatic, and in all probability has existed among the industrious nations of India from a very early period. It is used not only for all grains, but also for the culture of tobacco, cotton, and the castor-oil plant. Besides the drill-plough, and the common plough, the Indians use a third, with a horizontal share, which immediately follows the drill-plough at work. It is set into the earth about the depth of 7 or 8 inches, and passes under three drills at once. It operates by agitating the earth, so as to make the sides of the drills fall in and cover the seed, which it does so effectually as scarcely to leave any traces of a plough.

PART II.

CULTIVATION OF VEGETABLES MORE PROPERLY ARTICLES OF COMMERCE.

THESE in general are such as cannot be used for food; and are principally flax, hemp, rape, hops, and timber of various kinds. Of each of these we shall treat particularly in the following sections.

SECT. I.

OF FLAX AND HEMP.

Flax and
hemp.

Linseed-
cake, lin-
seed itself,
and linseed
oil, used for
fattening
cattle.

FLAX is cultivated not only with a view to the common purposes of making linen, but for the sake of its seed also; and thus forms a most extensive article of commerce, all the oil used by painters, at least for common purposes, being extracted from this seed. The cake which remains after the extraction of the oil is in some places used as a manure, and in others sold for fattening of cattle. In the Vale of Gloucester, Mr Marshal informs us, that it is, next to hay, the main article of stall-fattening; though the price is now become so great, that it probably leaves little or no profit to the consumer, having within a few years risen from
three

three guineas to six and six and a half, and the lowest price being five guineas per ton; and even this is lower than it was lately. Hence some individuals have been induced to try the effect of linseed itself boiled to a jelly, and mixed with flour, bran, or chaff, with good success, as Mr Marshal has been informed; and even the oil itself has been tried for the same purpose in Herefordshire. Though this plant is in universal culture over the whole kingdom, yet it appears by the vast quantity imported, that by far too little ground is employed in that way. As Mr Marshal takes notice of its culture only in the county of Yorkshire, it probably does not make any great part of the husbandry of the other counties of which he treats; and even in Yorkshire he tells us, that its cultivation is confined to a few districts. The kind cultivated there is that called *blea line*, or the *blue or lead-coloured flax*, and this requires a rich dry soil for its cultivation. A deep, fat, sandy loam is perhaps the only soil on which it can be cultivated with advantage. If sown upon old corn land, it ought to be well cleaned from weeds, and rendered perfectly friable by summer-fallow. Manure is seldom or ever set on for a line crop: and the soil process consists generally of a single ploughing. The seed-time is in the month of May, but much depends on the state of the soil at the time of sowing. "It should neither be wet nor dry; and the surface ought to be made as fine as that of a garden bed. Not a clod of the size of an egg should remain unbroken." Two bushels of seed are usually sown upon an acre: the surface, after being harrowed, is sometimes raked with garden or hay rakes; and the operation would be still more complete if the clods and other obstructions,

Flax and
Hemp.

Culture of
flax in
Yorkshire.

Flax and Hemp. which cannot be easily removed, were drawn into the interfurrows. A light hand-roller used between the final raking and harrowing would much assist this operation. The chief requisite during the time of vegetation is weeding, which ought to be performed with the utmost care; and for this reason it is particularly requisite that the ground should be previously cleaned as well as possible, otherwise the expence of weeding becomes too great to be borne, or the crop must be considerably injured. It is an irreparable injury, if, through a dry season, the plants come up in two crops; or if by accident or mismanagement they be too thin. The goodness of the crop depends on its running up with a single stalk without branches: for wherever it ramifies, there the length of the line terminates; and this ramification is the consequence of its having too much room at the root, or getting above the plants which surround it. The branches are never of any use, being unavoidably worked off in dressing; and the stem itself, unless it bear a due proportion to the length of the crop, is likewise worked off among the refuse. This ramification of the flax will readily be occasioned by clods on the ground when sown. A second crop is very seldom attended with any profit; for being overgrown with the spreading plants of the first crop, it remains weak and short, and at pulling time is left to rot upon the land.

Flax is injured not only by drought but by frost, and is sometimes attacked, even when got five or six inches high, by a small white slug, which strips off the leaves to the top, and the stalks bending with their weight are thus sometimes drawn into the ground. Hence, if the crop does not promise fair at weeding time,

time, our author advises not to bestow farther labour and expence upon it. A crop of turnips or rape will generally pay much better than such a crop of flax. The time of flax-harvest in Yorkshire is generally in the latter end of July or beginning of August. Flax and Hemp.

On the whole, our author remarks, that "the goodness of the crop depends in some measure upon its length; and this upon its evenness and closeness upon the ground. Three feet high is a good length, and the thickness of a crow's quill a good thickness. A fine stalk affords more line and fewer shivers than a thick one. A tall thick set crop is therefore desirable. But unless the land be good, a thick crop cannot attain a sufficient length of stem. Hence the folly of sowing flax on land which is unfit for it. Nevertheless, with a suitable soil, a sufficiency of seed evenly distributed, and a favourable season, flax may turn out a very profitable crop. The flax crop, however, has its disadvantages: it interferes with harvest, and is generally believed to be a great exhauster of the soil, especially when its seed is suffered to ripen. Its cultivation ought therefore to be confined to rich grass-land districts, where harvest is a secondary object, and where its exhaustion may be rather favourable than hurtful to succeeding arable crops, by checking the too great rankness of rich fresh broken ground." Mr Marshall's remarks on flax crops.

In the 5th volume of Bath Papers, Mr Bartley, near Bristol, gives an account of the expences and produce of five acres of flax cultivated on a rich loamy sand. Mr Bartley's experiments.
The total expence was 42l. 13s. 4d.; the produce was ten packs of flax at 5l. 5s. value 52l. 10s. 35 bushels of linseed at 5s. value 8l. 15s.: the net profit therefore was 18l. 11s. 8d. or 4l. 13s. 4d. per acre. This gentleman is of opinion that flax-growers ought to make it

Flax and Hemp. their staple article, and consider the other parts of their farm as in subserviency to it.

Remarks by a Dorsetshire gentleman. In the second volume of Bath Papers, a Dorsetshire gentleman, who writes on the culture of hemp and flax, gives an account somewhat different from that of Mr Marshal. Instead of *exhausting* crops, he maintains that they are both *ameliorating* crops if cut without feeding; and as the best crops of both are raised from foreign seed, he is of opinion that there is little occasion for raising it in this country. A crop of hemp, he informs us, prepares the land for flax, and is therefore clear gain to the farmer. "That these plants impoverish the soil," he repeats, "is a mere vulgar notion, devoid of all truth.—The best historical relations, and the verbal accounts of honest ingenious planters, concur in declaring it to be a vain prejudice, unsupported by any authority; and that these crops really meliorate and improve the soil." He is likewise of opinion, that the growth of hemp and flax is not necessarily confined to rich soils, but that they may be cultivated with profit also upon poor sandy ground, if a little expence be laid out in manuring it. "Spalding-moor in Lincolnshire is a barren sand; and yet with proper care and culture it produces the best hemp in England, and in large quantities. In the isle of Atholme, in the same county, equal quantities are produced; for the culture and management of it is the principal employ of the inhabitants; and, according to Leland, it was so in the reign of Henry VIII. In Marshland. the soil is a clay or strong warp, thrown up by the river Ouse, and of such a quality, that it cracks with the heat of the sun, till a hand may be put into the chinks; yet if it be once covered with the hemp

Flax and hemp may be cultivated upon poor as well as rich soils.

hemp or flax before the heats come on, the ground will not crack that summer. When the land is sandy, they first sow it with barley, and the following spring they manure the stubble with horse or cow dung, and plough it under. Then they sow their hemp or flax, and harrow it in with a light harrow, having short teeth. A good crop destroys all the weeds, and makes it a fine fallow for flax in the spring. As soon as the flax is pulled, they prepare the ground for wheat. Lime, marl, and the mud of ponds, is an excellent compost for hemp-lands.”

Flax and
Hemp.

Our author takes notice of the vast quantity of flax and hemp, not less than 11,000 tons, imported in the year 1763 into Britain; and complains that it is not raised in the island, which he thinks might be done, though it would require 60,000 acres for the purpose. He observes, that the greater part of those rich marshy lands lying to the west of Mendip hills are very proper for the cultivation of hemp and flax; and if laid out in this manner could not fail of turning out highly advantageous both to the landholders and the public at large. “The vast quantities of hemp and flax (says he) which have been raised on lands of the same kind in Lincolnshire marshes, and the fens of the Isle of Ely and Huntingdonshire, are a full proof of the truth of my assertion. Many hundreds of acres in the above-mentioned places, which, for pasturage or grazing, were not worth more than twenty or twenty-five shillings per acre, have been readily let at 4l. the first year, 3l. the second, and 2l. the third. The reason of this supposed declining value of land, in proportion to the number of years sown with flax, is, that it is usual with them to seed it for the purpose of making oil, that be-

Vast quantities of flax and hemp imported into Britain.

Flax and Hemp, being the principal cause of the land being thereby impoverished, verified.

It is certain, that the quantity of hemp exported from St Petersburg in British ships has continued to increase, even in time of peace, so that in 1785 the quantity of hemp exported from Petersburg in British ships was as follows :

	Poods.
Of clean hemp, -	1,038,791
Outshot, - -	37,382
Half clean, - -	18,374
Hemp codille, - -	19,251

1,113,798

Mr Durno's
report on
the culture
of flax and
hemp in
Prussia, &c.

There are 63 poods to a ton, consequently the whole amounted to 17,695 tons; and it is said that this quantity has since been tripled and quadrupled. It is therefore an object of great national importance to consider, whether flax and hemp might not be profitably reared in our own country without producing any alarm concerning their tendency to exhaust the soil. With this view we shall here state the substance of a report made by Mr Durno, British consul at Prussia in 1789, to the lords of the Committee of Council for Trade, concerning the method of cultivating flax and hemp in Prussia, Russia, and Poland.

A black, not morassy, open gravelly soil is preferred, as flax and hemp become exuberant and coarse on too rich a soil. To ascertain the proper middle degree of strength of soil, previous crops of grain are taken. On a vigorous soil wheat is first sown; then rye, barley, oats; and last of all flax or hemp. Two successive crops:

crops of hemp are taken if the land is intermediately dunged. For one crop of flax, it is not dunged at all. On a soil of less strength, flax and hemp are sown immediately after a winter crop of rye, the land being ploughed in autumn, if the weather allows; if not, in spring. It is then harrowed and manured, and again ploughed immediately before sowing. Another winter crop of rye may immediately be sown in the same field after drawing the flax or hemp; but after the flax, dung is in this case necessary. A field that has been laid down in fallow, if only ploughed up, yields a better crop of flax than if manured and cultivated in the above or any other way. Flax and hemp are sown from the 25th of May to the 10th of June, and the flax is reaped in the end of August, and hemp in the end of September.

As to their effects on the soil, no kind of grain can be sown immediately after a crop of flax without dunging, but after one of hemp, any grain, and even hemp itself, may be sown without manure. Hemp cleans the ground by suffocating, by its broad leaves, all sorts of weeds or undergrowth; but flax must be weeded once or twice before it blooms. Flax is plucked when the stalk becomes yellowish, the pods brown, and the seed hard and full bodied. For finer flax, the stalk is pulled while yet green; but the seed is then sacrificed, and fit only for crushing for oil, of which it produces a small quantity. Hemp is also plucked or drawn when the stalk and pods have changed colour. If the flax is very dry when plucked, the seed is stripped off immediately; if not, it is allowed to dry on the field. The seed-pods are spread thinly on a floor, where they are turned twice a-day, till so dry that they open of themselves;

Flax and Hemp. selves ; when it is thrashed and cleaned like other grain. To gain the hemp-feed, the hemp itself, when plucked, is set on end against any convenient place. The roots, and top-ends are then cut off. The roots are thrown away, and the top-ends are thrashed out and cleaned. The feed is apt to be spoiled by remaining in a moist state for any length of time.

As soon as the seed has been gained, the flax and hemp are steeped in water till the flax separate from the rind, and the hemp till the harl springs from the stalk. In soft water, in warm weather, nine or ten days are sufficient for this purpose. In hard water, with cold weather, from fourteen days to three weeks are requisite. Stagnate is preferred to running water ; but fish ponds and the drinking places of cattle must be avoided, as the fish would be destroyed, and the water would be rendered unwholesome and unpalatable to the cattle ; but a muddy or slimy bottom is preferred. In the southern provinces of Poland, as Volhinia, Podolia, &c. steeping is not practised, on the supposition that it weakens the harl and darkens the colour, though this idea seems to have no foundation.

After being taken out of the steep, the flax is dried on a grass field ; after which it is gathered up into small stacks ; but the hemp, instead of being spread out on a field, is set up against the walls of buildings till it is also dried, after which they are both housed.

It is generally understood in these countries, that the cultivation of flax and hemp is more profitable than that of any kind of grain.

The following is described by an American gentleman,

man, Edward Antill, Esq. *, as the best mode of raising Flax and Hemp. The soil ought by no means to be wet, but ought to be well dunged, and rendered American culture of hemp. strong and mellow. "Some time in May, the ground being moist and in a vegetating state, but by no means wet, must be well ploughed, the furrows must be close and even, and the soil must lie light and mellow; it must then be sown very even, with two bushels of seed upon one acre. A man with an iron-tooth harrow follows the sower, and harrows in the seed with two horses, without any balks; for the less the ground is trampled the better. If harrowing one way be not sufficient to cover the seed, though it would be best if that could be done, it must be cross harrowed. The ground being moist, as I said before, but by no means so wet as to clod, which would ruin the crop, the seed will all start and come up together, which is a sure sign of a good crop, and nothing after that, but too much wet, will hurt it; for hemp thus come up bids defiance to weeds and grass of every kind. Its growth is so quick, and it so effectually shades the ground, that nothing below can rise, or show its head; and it so preserves all the moisture below, that the hotter and drier the weather the faster it grows. Whereas, if the seed be sown when the ground is dry, the seed that lies deepest where the moisture is, will come up first, and these plants will shade and starve those that come up after; by which means the first comers will be too large, and the last will be much too small, so that the crop will be greatly damaged every way: so much depends upon this

* *American Philosophical Society's Transactions.*

Flax and Hemp. this one circumstance of sowing the seed when the ground is moist and fit to receive it. The crop thus rightly managed will stand as thick as very good wheat, and be from four to six feet high, according to the strength of the ground, and the stems will not be thicker than a good wheat straw; by this means the hemp will be finer; it will yield the greater quantity; and it may be plucked from the ground, like flax, which will be a great saving. But if it be sown thin, that is, one bushel to an acre, which is the common practice, it grows large: the hemp is harsh and coarse, and then it must be cut with hooks, which occasions great waste; for four or five inches above the ground is left by way of stubble, which contains the best and heaviest parts of the hemp.

“When the hemp has got its growth, and is fit to be plucked, which you will know by the under leaves of the carle or male hemp turning yellow and falling off, the sooner it is pulled the better. It must then be bound up with straw bands, in single band sheaves, rather small than large, and each sheaf must be bound in two places, and the sooner it is carried to the water to rot the better. Water-rotted hemp, if it be rightly managed, is every way better than that which is rotted on the ground; there is less waste in it, when it comes to be dressed; it looks brighter and fairer to the eye; it is esteemed to be stronger and more durable, and it always fetches a better price; besides it is much sooner done, and it is rotted more even and alike, and with greater certainty and exactness. Hemp may be rotted in stagnated or standing water; such as ponds, pools, or broad deep ditches; and in such water it is generally four or five days and nights in rotting, and sometimes longer.

longer, according to the heat or coolness of the weather. It may also be rotted in running water, as in a brook or river; and in such water three or four days and nights are sufficient, according to the weather. To know whether the hemp is rotted enough in either case, take a middling handful out of the middle row, and try with both your hands to snap it asunder; if it breaks easily, it is rotted enough; but if it yet appear pretty strong, it is not, and must lie longer, till it breaks with ease; then it must be taken out, and dried as soon as possible. In handling the sheaves, take hold of the bands, and set them upright against a fence, if one be near, or lay them down upon the grass for the water to drain off; then unbind them carefully, open and spread them, that they may dry thoroughly; then bind them up again, and house them in a dry tight place. The reason of handling the hemp in this careful manner is, that when it is well rotted whilst it is wet the lint comes off with the least touch; therefore, if it be handled roughly, or if, while it is wet, it be thrown into a cart, and carried to a distance to be unbound and dried, it will be greatly hurt, and the owner will receive great damage; but, when it is dry, it may be handled with safety.

Flax and
Hemp.

“ If the hemp be rotted in a brook or running water, the sheaves must be laid across the stream; for, if they be laid down lengthways with the stream, the current of the water will wash away the lint and ruin the hemp; it must be laid down, heads and points, two, four, or six hick, according to the depth of the water, and the quantity of hemp. If the bottom of the river be sand, gravel, or mud, three good strong stakes must be driven down at each end, above and below, and three long strong

Flax and Hemp. strong poles must be laid on the hemp, and fastened well to the stakes, in such a manner as to force down the hemp under water, where it is to remain till it is rotted enough; though, if a muddy stream could be avoided, it would be best, because it is apt to foul and stain the hemp. If the bottom of the stream be rocky or stony, so that stakes cannot be driven down to secure the hemp under water, and prevent its floating away, then a rough wall must be made at the lower end of the hemp, and along the side, to keep it in; and strong poles or rails must be laid upon the top of the hemp, and pretty heavy stones upon them, so as to sink the hemp under water, where it must lie till it is rotted enough."

**Culture of
flax in Ire-
land.**

To this we shall add a concise statement of the mode of cultivating flax in Ireland. A good crop of flax is there expected from any strong clays that are fit for the growth of corn; but an open black loamy soil, enriched by having lain long in pasture, is preferable. The ground must be in fine tilth, and as free from weeds as possible. Potatoes usually precede flax, though turnips, beans, or any manured crop, are a good preparation; but the first or second crop after pasture is preferred to any of these. Stubble lands, that have been long in tillage, may, by proper preparation, bring a crop; but it is apt to fail in such situations, the stalks turning to a reddish colour, called *firing*, before it ripens; upon which it must immediately be pulled. Two bushels of seed are used to the English acre, unless for the purpose of a very fine manufacture; in which case a large quantity of seed is used, and the flax is pulled very green. The season of sowing is the first fine weather after the middle of March. The

most approved mode of culture is in beds about six feet ^{Flax and Hemp.} broad, covering the seed about an inch and a half deep, with earth shoveled out of the furrows: but the most ordinary mode is to sow on common ridges, and to harrow in the seed. Before the flax is five inches high it should be carefully hand-weeded; and, if any part lodges, it should be turned over. The produce is usually worth 7l. sterling the English acre. The crop should stand till the lower part of the stalk becomes yellowish, and the under leaves begin to wither, unless the seed is to be preserved, which is done by rippling it through an iron comb, and the flax may be steeped immediately after it is pulled. Turf-bog water, if clear, answers well; but foul stagnated water stains the flax. Too pure a spring is injurious. A reservoir dug in clay is preferred. The time of lying in the steep depends upon the quality of the water and the state of the weather. It is dried on grafs by being spread thin. Artificial heat has been recommended for drying flax; but no good form of it has been suggested.

In addition to what is here stated, it may not be im-^{Sheep em-}proper to take notice of a mode of weeding flax that has ^{ployed to} frequently been practised in Scotland. It consists of turning a flock of sheep at large into the field. They will not taste the young flax plants, but they carefully search for the weeds, which they devour. It may also be remarked, that for drying flax in wet seasons, the steam kiln formerly proposed would be a valuable instrument.

Rape or
Cole-Seed.

SECT. II.

RAPE OR COLE-SEED

THIS, as well as linseed, is cultivated for the purpose of making oil, and will grow almost anywhere. Mr Hazard informs us *, that in the north of England the farmers pare and burn their pasture lands, and then sow them with rape after one ploughing; the crop commonly standing for seed, which will bring from 25l. to 30l. per last (80 bushels). Poor clay, or stone-brash land, will frequently produce from 12 to 16 or 18 bushels per acre, and almost any fresh or virgin earth will yield one plentiful crop; so that many in the northern counties have been raised, by cultivating this seed, from poverty to the greatest affluence. The seed is ripe in July or the beginning of August; and the thrashing of it out is conducted with the greatest mirth and jollity.

Advantage
of cultivat-
ing rape-
seed.

Of cutting
and thrash-
ing the
rape-seed.

The rape being fully ripe, is first cut with sickles, and then laid thin upon the ground to dry; and when in proper condition for thrashing, the neighbours are invited, who readily contribute their assistance. The thrashing is performed on a large cloth in the middle of the field, and the seed put into the sacks and carried home. It does not admit of being carried from the field in the pod in order to be thrashed at home, and therefore

* *Bath Papers*, vol. iv.

fore the operation is always performed in the field ; and by the number of assistants procured on this occasion, a field of 20 acres is frequently thrashed out in one day. The straw is burnt for the sake of its alkali, the ashes being said to equal the best kind of those imported from abroad.

The proper time for sowing rape is the month of June ; and the land should, previous to the sowing, be twice well ploughed. About two pounds of seed are sufficient for an acre ; and, according to our author, it should be cast upon the ground with only the thumb and two fore fingers ; for if it be cast with all the fingers, it will come up in patches. If the plants come up too thick, a pair of light harrows should be drawn along the field lengthwise and crosswise ; by which means the plants will be equally thinned ; and when the plants which the harrows have pulled up are withered, the ground should be rolled. A few days after, the plants may be set out with a hoe, allowing 16 or 18 inches distance betwixt every two plants.

Mr Hazard strongly recommends the transplanting of rape, having experienced the good effects of it himself. A rood of ground, sown in June, will produce as many plants as are sufficient for 10 acres ; which may be planted out upon ground that has previously borne a crop of wheat, provided the wheat be harvested by the middle of August. One ploughing will be sufficient for these plants ; the best of which should be selected from the seed-plot, and planted in rows two feet asunder and 16 inches apart in the rows. . As rape is an excellent food for sheep, they may be allowed to feed upon it in the spring ; or the leaves might be gathered, and given to oxen or young cattle : fresh

Rape or
Cole-Seed.

Of sowing
it.

Transplant-
ing recom-
mended.

Sheep may
be fed in
the spring
with rape.

Rape or
Cole-Seed.

leaves would spread again from the same stalks, which in like manner might be fed off by ewes and lambs in time enough to plough the land for a crop of barley and oats. Planting rape in the beginning of July, however, would be most advantageous for the crop itself, as the leaves might then be fed off in the autumn, and new ones would appear in the spring. Our author discommends the practice of sowing rape with turnips, as the crops injure one another. "Those who look for an immediate profit (says he), will undoubtedly cultivate rape for feed; but perhaps it may answer better in the end to feed it with sheep: the fat ones might cull it over first, and afterwards the lean or store sheep might follow them, and be folded thereon; if this is done in the autumn season, the land will be in good heart to carry a crop of wheat; or, where the rape is fed off in the spring, a crop of barley might follow. In either case rape is profitable to the cultivator; and when it is planted, and well earthed round the stems, it will endure the severest winter; but the same cannot be advanced in favour of that which is sown broadcast.

Northamptonshire
culture.

The mode of cultivating and using rape or cole for the purpose of fattening sheep, is thus described by a Northamptonshire farmer *. "The preparation for it is exactly the same as for turnips; and it should be hoed in the same stages of its growth, but not more than six inches asunder. The quantity of seed, half a peck, Winchester, upon a statute acre.

"The time for sowing for the fattening sheep is about

* *Annals of Agriculture*, vol. xxiv.

about midsummer, or ten days or a fortnight before or after, according as the land is in condition; and, for this purpose the strongest and best of the land is selected. Such as is meant for lamb hogs or store sheep, is sowed later, and upon inferior land. The reason of this distinction is, that, being a much stronger food than any other vegetable, the sheep are required to be in a state of forwardness, proportioned in some degree to the luxuriance of the plant; for if the sheep are poor, and the cole-seed is strong, they will either scour themselves to death, or die of the rack; a species of mortification brought on by thriving too fast. Indeed it is generally understood, that there is always a degree of hazard attending it on this account; and I have known very great losses sustained by the death of sheep; but I think they have been owing to injudicious management. I have used it myself for many years, and never experienced any loss but once, which was the year before last; and that I suppose to have been owing to inattention, in my absence, to my usual plan of conducting this part of the grazing business, which I will endeavour to explain.

“My portion of land used with cole-seed is about 30 acres, and the number of sheep intended to be wintered from two hundred to three hundred. About the 10th of August I begin to draw the leanest of the sheep, and turn them into the cole-seed, beginning with ten only, which go over the whole ground if they please; in a few days ten more are turned in; and ten at a time, until about half of the whole number is upon the cole-seed; always taking care to keep back the forwardest and fattest of the sheep; which last are kept at grass perhaps till near Christmas; and by that time the others, which

Rape or
Cole-Seed.

were the leanest at the outset, will be completely fat for market; they are never moved or driven about, or penned, for fear of heating them; but the number wanted to be taken to market is carefully separated, and put into the nearest pasture-land, to empty themselves a few days before they go into the drovers hands."

Culture of
rape-feed
in Brabant.

Cole-feed is cultivated in Brabant in the following manner, according to the Abbe Mann. "It is sown about the middle of July, and the young plants are transplanted about the end of September. This is done with a narrow spade sunk into the ground, and moved with the hand forwards and backwards; which simple motion makes a sufficient opening to receive the plant; a boy or a girl follows the labourer with plants, and putting one of them into each hole, treads against it to close it up. If the plantation is done with the plough, the plants are placed at regular distances in the furrow, and are covered with the earth turned up with the succeeding furrow. Sometimes, after the cole-feed is planted, the foot of the stalks is covered, by means of a common spade or hoe, with the earth near it, which furnishes nourishment for the plants during winter, by the crumbling of these little clods of earth over the roots. The cole-feed is reaped about midsummer or later, according as the season is more or less advanced; it is left on the field for ten or twelve days after it is cut, and then thrashed on a kind of sail-cloth, spread on the ground for that purpose, and the seed carried in sacks to the farm. When the crop is good, a bunder produces about forty raziers of 80lb. weight each. It is to be observed, that the ground whereon cole-feed is to be planted, must be dunged and twice ploughed the same year it is put in use."

The

The cultivation of cole-seed in Flanders is thus described by Mr Young: "Near this town (Cambray) I met first with the culture of cole-seed; they call it *gofu*. Sow the seed thick on a seed-bed for transplanting, setting it out on an oat stubble after one ploughing. This is so great and striking an improvement of our culture of the same plant, that it merits the utmost attention; for saving a whole year is an object of the first consequence. The transplanting is not performed till October, and lasts all November, if no frost; and at such a season there is no danger of the plants not succeeding: earlier would, however, surely be better, to enable them to be stronger rooted to withstand the spring frosts, which often destroy them; but the object is not to give their attention to this business till every thing that concerns wheat-sowing is over. The plants are large, and two feet long; a man makes the holes with a large dibble, like the potato one used on the Essex side of London, and men and women fix the plants at 18 inches by 10 inches; some at a foot square; for which they are paid nine livres per manco of land. The culture is so common all the way to Valenciennes, that there are pieces of two, three, and four, acres of seed-bed now cleared or clearing for planting."

Coriander-
Seed.

SECT. III.

CORIANDER-SEED, CARAWAY, &c.

Mr Bart-
ley's expe-
riment.

THIS is used in large quantities by distillers, druggists, and confectioners; and might be a considerable object to such farmers as live in the neighbourhood of great towns: but the price is very variable; viz. from 16s. to 42s. per cwt. In the 4th volume of the Bath Papers, Mr Bartley gives an account of an experiment made on this seed, which proved very successful. Ten perches of good sandy loam were sown with coriander on the 23d of March 1783. Three pounds of seed were sufficient for this spot; and the whole expence amounted only to 5s. 10d. The produce was 87 pounds of seed, which, valued at 3d. yielded a profit of 5s. 11d. or 15l. 18s. 4d. per acre. He afterwards made several other experiments on a larger scale; but none of the crops turned out so well, though all of them afforded a good profit.

Coriander,
caraway,
and teasel,
mixed.

In the 21st volume of the Annals of Agriculture, the following description is given by John Sewell, Esq. of the mode of raising a mixed crop of coriander, caraway, and teasel. "About the beginning of March plough some old pasture land; if it has been pasture for a century the better, and the soil should be very strong clayey loam. Mix 12lb. of caraway, 10lb. of coriander, and 12lb. of teasel seed, together, which is sufficient for one acre; sow directly after the plough, and dress, (I suppose *harrow*) the land well. When the plants

plants appear of sufficient strength to bear the hoe (which will not be until ten weeks after sowing), it must not be omitted; and, in the course of the summer, it will require three hoeings, and one at Michaelmas; each will be about 8s. per acre. The coriander is annual, and is fit to cut about the beginning of July; should be left in the field after cutting, and thrashed on a cloth, in the same manner as rape-feed. About April following, your teasel and caraway will want a good hoeing, done deep and well, and another hoeing about the beginning of June; these two hoeings are to be done at 7s. per acre each. The caraway will be fit to cut the beginning of July; and must be thrashed in the same manner as coriander. The teasel will not be ready till the middle of September, when those heads which are beginning to turn brown are cut off the stem with a stalk a foot long, and 25 of them are tied in a bunch; 24 of the bunches are fixed on a small stick, and called a *row*, 240 of which make a load in bulk, equal to a ton of hay for the meadow. The work of cutting and bunching the teasel can only be done by those who have been well acquainted with and learned the mode; it must be looked over, and the heads cut at several times as they ripen. The teasel and caraway are perennial, and some of the plants do not perfect their seeds till the third or fourth year; though in general you have a crop the second year, yet enough are left for a crop the third year, and the seeds that are scattered from the crop the second year often come to perfection the fourth year; so that I have known instances of its being continued for seven years. The usual way is to plough directly after the crop is gathered the third year, and sow wheat; of which commonly

Coriander-
Seed.

a very good crop is obtained, the land being in fine order, from the turf being rotted and the repeated hoeings. The first appearance of teasel, after sowing, is much like a lettuce; coriander like a parsnip; and caraway exactly like carrots. The produce of caraway has often been on the very rich old leys, in the hundreds, or low lands, of this county, 20 cwt. per acre. There is always a demand for it in the London market, sometimes so low as 12s. per cwt. and it has been up to 50s. per cwt. mostly on an average at 21s. Coriander is also very productive on good land, often producing 24 cwt. per acre, sometimes not more than 6 or 7 cwt.; the price being sometimes 30s. per cwt; often as low as 10s.; average in general about 16s. London market. Teasel is used only, among the manufacturers of ordinary cloth and baize, to raise the wool on them that covers the thread. As we have a large business of that kind carried on in this part of the country, we have a regular demand for teasel; the average price about 12l. per load; the produce sometimes a load per acre; often not more than one-fourth of a load. The land can only be filled with plants; and the more one kind predominates, the less must reasonably be expected of the crop that succeeds. It is mostly sown on land so strong as to require being a little exhausted, to bring it fit for bearing corn. Most of the land is sown with caraway and coriander; the teasel is omitted as being a more troublesome and uncertain crop; and generally the product of caraway is much greater without than with teasel."

SECT. IV.

CANARY-SEED.

THIS is cultivated in large quantity in the Isle of Thanet, where it is said they have frequently 20 bushels to an acre. Mr Bartley, in the month of March 1783, sowed half an acre of ground, the soil a mixture of loam and clay; but had only eight bushels and a half, or 17 bushels per acre. With this produce, however, he had a profit of 4l. 2s. 3d. per acre.

SECT. V.

WOAD.

THE use of this in dyeing is well known; and the consumption is so great, that the raising of the plant might undoubtedly be an object to a husbandman, provided he could get it properly manufactured for the dyers, and could overcome their prejudices. At present the growing of this plant is in a manner monopolized by some people in particular places, particularly at Keynsham near Bristol in England. Mr Bartley informs us, that in a conversation he had with these growers, the latter asserted, that the growth of woad was peculiar to their soil and situation. The soil about this place is a blackish heavy mould, with a considerable

Woad. able proportion of clay, but works freely: that of Brislington, where Mr Bartley resides, a hazel sandy loam; nevertheless, having sowed half an acre of this soil with woad-seed, it thrived so well, that he never saw a better crop at Keynsham. Having no apparatus, however, or knowledge of the manufacture, he suffered it to run to seed, learning only from the experiment, that woad is very easily cultivated, and that the only difficulty is the preparing it for the market.

SECT. VI.

HOPS.

Hops forbidden by act of parliament.

THE uses of these, as an ingredient in malt liquors, are well known. Formerly, however, they were supposed to possess such deleterious qualities, that the use of them was forbid by act of parliament in the reign of James VI. But though this act was never repealed, it does not appear that much regard was ever paid to it, as the use of hops was still continued, and is found not to be attended with any bad effect on the human constitution. The only question, therefore, is, How far the raising a crop of them may be profitable to the husbandman? and indeed this seems to be very doubtful.

Mr Arthur Young, in a Fortnight's Tour through Kent and Essex, informs us*, that at Castle Hedingham he

* *Annals of Agriculture*, vol. ii.

he was told by a Mr Rogers, who had a considerable hop-plantation, that four acres of hop-ground cost him upwards of 120l. and that the usual expences of laying out an acre of ground in this way amounted to 34l. 6s. By a calculation of the expences of an acre in Kent, it appeared that the money sunk to plant an acre there amounted to 32l. 8s. 6.; that the annual expence was 23l. and the profit no more than 11. 8s. 1d. In another place, he was informed by a Mr Potter, who cultivated great quantities of hops, that if it were not for some extraordinary crops which occurred now and then, nobody would plant them. In Essex, the expences of a hop-plantation are still greater than those we have yet mentioned; an acre many years ago requiring 75l. to lay it out in hops, and now not less than 100l. the annual expence being estimated at 31l. 1s. while the produce commonly does not exceed 32l.

In the neighbourhood of Stow-market in this county, Mr Young informs us, there are about 200 acres planted with hops, but "18 or 20 are grubbed up within two years, owing to the badness of the times." Here they are planted on a black loose moor, very wet and boggy; and the more wet the better for the crop, especially if the gravel, which constitutes the bottom, be not more than three feet from the surface. In preparing the ground for hops, it is formed into beds, 16 feet wide, separated from each other by trenches. In these beds they make holes six feet asunder, and about 12 inches diameter, three rows upon a bed. Into each hole they put about half a peck of very rotten dung or rich compost, scatter earth upon it, and plant seven sets in each; drawing earth enough

Hops. enough to them afterwards to form something of a hillock. A hop-garden, Mr Young informs us, "will last almost for ever, by renewing the hills that fail, to to the amount of about a score annually, but it is reckoned better to grub up and new-plant it every 20 or 25 years."

**Profit of
breaking
up hop-
land prece-
rious.**

In this volume of the Annals, Mr Young informs us, that "one profit of hop-land is that of breaking it up. Mr Potter grubbed up one garden, which failing, he ploughed and sowed barley, the crop great; then mazagan beans, two acres of which produced 16 quarters and five bushels. He then sowed it with wheat, which produced 13 quarters and four bushels and a half: but since that time the crops have not been greater than common. The same gentleman has had 10 quarters of oats after wheat." In the ninth volume of the same work, however, we have an account of an experiment by Mr Le Bland of Sittingbourn in Kent, of grubbing up twelve acres of hop-ground, which was not attended with any remarkable success. Part of the hops were grubbed up in the year 1781, and mazagan beans sown in their stead: but by reason of the seed being bad, and the dry summer, the crop turned out very indifferent. Next year the remainder of the hops were grubbed up, and the whole 12 acres sown with wheat; but still the crop turned out very bad, owing to the *wet* summer of that year. It was next planted with potatoes, which turned out well: and ever since that time the crops have been good. This gentleman informs us, that the person who had the hop-ground above-mentioned did not lose less by it than 1500l.

The

The culture of hops seems to be confined in a great measure to the southern counties of England; for Mr Marshal mentions it as a matter of surprise, that in Norfolk he saw a "tolerably large hop-garden." The proprietor informed him, that three or four years before there had been 10 acres of hops in the parish (Blowfield) where he resided; which was more than could be collected in all the rest of the county; but at that time there were not above five: and the culture was daily declining, as the crops, owing to the low price of the commodity, did not defray the expence.

From all this it appears, that hops are perhaps the most uncertain and precarious crop on which the husbandman can bestow his labour. Mr Young is of opinion, that some improvement in the culture is necessary; but he does not mention any, excepting that of planting them in espaliers. This method was recommended both by Mr Rogers and Mr Potter above mentioned. The former took the hint from observing, that a plant which had been blown down, and afterwards shot out horizontally, always produced a greater quantity than those which grew upright. He also remarks, that hops which are late picked carry more next year than such as are picked early; for which reason he recommends the late picking. The only reason for picking early is, that the hops appear much more beautiful than the others.

SECT. VII.

WHITE BEET.

WHEN treating of plants cultivated for their roots, we took notice of the beet or root of scarcity. We account it necessary, however, to resume the subject in this part of the work, in consequence of an attempt now making in the northern parts of the continent of Europe, to render the cultivation of this root the means of producing one of the most valuable articles of commerce, which has hitherto been regarded as peculiarly appropriated to the more fertile regions of the torrid zone. It appears, that after labouring many years upon the subject, F. C. Achard, director of the physical class in the Royal Academy of Sciences at Berlin, has published an account of a mode of cultivating the white beet so as to render it capable of producing large quantities of the finest sugar; the process for extracting it, in a cheap and easy manner, he has described. The king of Prussia has given great encouragement to the plan, which is said to have been pursued with success by various persons. The emperor of Russia is endeavouring to introduce it into his dominions; and it has engaged the attention of the men of letters and the government of France. As the climate of Prussia, where this discovery is said to have been made, is not better than our own, and as the soil is inferior, there is no doubt, that, if the discovery shall ultimately prove even of much less value than it has been represented, a considerable

considerable change will be produced by means of it in the ^{White Beet.} objects of European agriculture : and the inhabitants of the temperate climates will cease to be dependant for what is now almost one of the necessities of life, upon industry exerted in the unhealthy regions between the tropics. Either in this point of view, or as a matter of agricultural curiosity, we shall state to our readers the nature of the discovery in question ; and that we may do it the more justice, we shall give it in the words of the inventor himself.

“ In the course of several years past (says M. Achard), I have made experiments to ascertain how far various native plants might be fit for making sugar. In these inquiries I had the opportunity of observing, that the quantity of saccharine matter, and its proportion to the other constituent parts of the same species of plants, may be increased or diminished by the manner of cultivation.

2. “ Among the various plants which I examined for the purpose of making sugar in this country, I paid particular attention to the several species of *beta vulgaris Linnæi*; one of which, peculiarly proper for manufacturing sugar, is known to the economist in this country by the name of *runkelruhe* *; and to the gardener, more especially, by the name of *mangoldruhe*. On comparing the several varieties of this kind of plants, I was convinced, that the particular variety possessed of a *long conical*
root,

* Bechmann describes the white beet in the following manner: *Beta altissima, floribus ternis vel quaternis, foliis calycis inermibus carinatis, caule crassissimo fasciato, radice maxima rubro et albo intus variegata, foliis maximis rubentibus.*

White Beet-root, red rind, and the interior part white, was the most abundant in sugar; and that the saccharine contents of this variety of the *beta vulgaris*, called *runkelruhe*, may be greatly augmented or diminished, according to the various methods of cultivating it.

3. "Having treated this root by various methods of culture, I obtained sugar from it with more or less profit; in some instances with loss, or even no sugar at all, but frequently a mere extract in the form of a pulp, smelling like turnip; in which, from the excess of extractive matter, no sugar could crystallize, unless some expensive artificial expedients, not applicable in the large way, had been employed. These observations have convinced me of the great influence of cultivation on the saccharine contents; and I spared no industry in order to discover the management by which this root might be cultivated of the greatest richness in sugar. I have not only raised them under various situations on my estate, French Buckholtz, but have procured such roots from various other territories, as from Magdeburgh, Halberstadt, Brunswick, Blankenburgh, Ciecstar, and Nauen, with accounts of the methods by which they were cultivated.

4. "I then compared the results of the experiments which I had instituted for the purpose of obtaining sugar, partly from roots of my own in different circumstances of growth, and partly from those of other sorts, which were likewise differently cultivated. By this means I have found that the saccharine matter of this root may be considerably increased, and the extractive matter considerably diminished. The conditions are,

(a) That it should be cultivated in a rich soil, which will be best adapted to it if it be rather compact.

(b) "The

(b) "The feed is not to be sown in one bed and the plants afterwards removed to another, as is commonly done; but, on the contrary, they must be suffered to ripen on the spot in which they germinate from their feeds. White Beet.

(c) "The roots must not be too distant from each other. In the best soil their mutual distance should be one foot; in a poorer soil, still nearer, nine inches at most.

(d) "After they have sprouted, they must be cleared of the weeds, either by the hoe or by pulling: taking care, when the hoe is used, that the earth be not removed from the plant, but rather, though slightly, brought nearer to it. This is not necessary when the weeds are pulled up. It is usual to remove the earth from the plant when it is cultivated to serve as food for cattle; for its upper part is, by this management, greatly enlarged, and it acquires a greater mass in the whole; but such management is highly detrimental to the runkelruhe intended for making sugar.

(e) "The leaves must not be taken off from the plant, as is the custom, for the purpose of feeding cattle. This treatment diminishes the saccharine matter of the root, at the same time that it increases its mucilaginous, earthy, and farinaceous parts; and consequently is very injurious to the quality of the root, if appropriated for making sugar."

5. "On these five positions, which are grounded on repeated experiments and observations I can with justice and truth insist; and that, with respect to the manufactory of native sugar, if carried on with profit from the runkelruhe, every thing depends on its proper culture. For it is by this means only that the in-

The quantity of sugar depends on the culture.

White Beet. crease of its saccharine contents can be promoted ; and it is only from the quantity of this last product, that sugar can be made with profit from that root in the large way.

Cheap sugar produced.

“ That this root contains sugar, has been long since proved by my celebrated predecessor in the Royal Academy of Sciences, the late director, Margraaf. But it was then unknown and unsuspected that it could be obtained from it in the large way, and so cheap as *two grosbes* (about three pence English) for the pound of crystalline raw sugar ; and in some trials still cheaper, as I have demonstrated to be practicable, by the experiments made in presence of the committee selected for that purpose by the king’s command. This result is different from all trials hitherto made, in this respect, by the most able chemists. The cause is simply, that the great influence which the culture of the runkelruhe has, with regard to the increase of its sugar, has not been suspected ; and that the different modifications of that culture were unknown ; though, in fact, the quantity of saccharine matter may, on the one hand, be highly augmented, while, on the other hand, the proportion of those constituent parts, which prevent the separation of the sugar, are greatly diminished.

6. “ From the method before described of producing the runkelruhe abundant in sugar, by means of a proper cultivation, and from my other observations on the most profitable management of this root, the following instructions may be taken for its cultivation.

Soil to be preferred.

“ A soil upon which wheat has grown is to be chosen, and kept in good condition. A low situation, not exposed to great or lasting drought, yet without being moist or swampy, is to be preferred. It is better if manured

nured the year before than recently; which, however, ^{White Beet.} must be done, if the former manuring has been omitted.

This ground is to be ploughed thrice over, and as deep ^{Culture detailed.} as the nature of the soil will admit. It is also very advantageous to perform, if possible, the first tillage in autumn. Immediately after the third ploughing, which should be done in the middle of April, or, at latest, about the middle of May; the ground is to be smoothed by the harrow as much as possible; and by means of a rake, whose teeth are distant from 9 to 12 inches, lines are to be traced along the surface, and by drawing the rake in lines across these, the ground becomes divided into squares, measured by the distance of the rake's teeth.

7. "Into each intersected part of the lines delineated by the rake, one single seed capsule, if you are convinced of its good quality, is to be stuck in. But if not, then two such capsules are to be put in; and in either case to the depth of an inch. This operation may be done by children or inferior labourers. When the plants have germinated out of the ground, and six or eight leaves are formed, the weeds must be pulled up; but as I have already observed, the removal of the earth from the plant is to be very carefully avoided. It answers better to press the earth nearer to the plant, though this may be neglected without any bad consequence. At this period of the culture there is another operation to be performed. If the plants be too much accumulated on a particular spot, which is often the case, when very good seed has been used, because one capsule contains several seed grains, and produces more plants than one on the same spot; in this case the superabundant plants are to be pulled out.

White Beet.

8. " There is no occasion for this operation, if the seed has not been quite fresh or not quite ripe. But in case some empty places should be found where nothing has grown up, two fresh grains should be inserted. After the ground has been once cleared of the weeds, the plants grow up so speedily, that their leaves soon completely cover the ground, and thus absolutely prevent the growing of any more weeds. In consequence of this, and to the great advantage of the farmer, an acre of ground cultivated with *runkelruhe* occasions no more trouble till the time of gathering; which circumstance greatly facilitates their cultivation, because the time of the cultivator, who is then busied in his corn harvest, is not required to be at all employed on this object: for the gathering of these roots begins only towards the end of September, and may be continued to the end of October, if no early frost sets in.

9. " At this gathering nothing particularly remarkable occurs, except that the root must be as little injured as possible; partly to prevent the loss of its juice, and partly to prevent the decay to which the wounded parts are more exposed than the sound ones. The verdure must be then cut off in such a manner, that the *heart* be also separated, in order to prevent the germination of the root. Too much, however, should not be lopped off the head, because the juice would, in that case, too plentifully exude. These leaves and hearts are exceedingly valuable to the farmer at this time, when other green food for his cattle is wanting.

10. " The roots may be kept for use in ditches dug in the earth, where the depth, the dryness, and the loose nature of the soil admit of it. Where this is not practicable, on account of the moistness and firmness of the soil,

foil, they may be preserved and secured against the frost in White Beet cellars. But the heart must not be taken out nor injured in such roots as are kept during the winter, in order to obtain seed from them by transplantation in the spring. The leaves are merely to be broken off. The roots must be well covered during winter, and sheltered against frost. In general, in the production of the seed from the *runkelruhe*, the same method is to be used as with other biennial roots and species of cole. As this procedure is known to every economist and gardener, I shall lose no time by describing it.

11. When large districts of ground are to be cultivated with this plant, the seed capsules cannot, for want of time, be singly put into the ground. The seed must, therefore, be sown with the greatest possible uniformity. The Magdeburg acre will require from three to four pounds of seeds, according to the quality of the soil. If the sowing has been well performed, the plants will be distant nine inches or a foot at most; in case the roots grow nearer to each other, they do not contain less sugar on this account, but they remain small. If too far asunder, they grow larger, but abound less in sugar. It is, therefore, less detrimental to sow too thick than too sparingly.

12. "It has before been remarked, that the practice of pulling the leaves from the plant ought to be carefully avoided; but this observation relates only to the green vegetating leaves. The ~~under~~ leaves frequently turn yellow and ~~die~~, and, in these circumstances of decay, they may be taken off, and will afford the farmer some assistance in a scarcity of food, without injury to the culture of our root.

13. "Respecting the choice of the seed, besides its
X 3 early

White Beet. early and perfect ripening, regard must be had, that it be not obtained from roots, which, after their germination, have been transplanted on seed-beds; but from such as remained on the spot where they grew from the capsules till autumn, and which likewise have produced the true oblong, thin, conical roots. This is necessary, because such a seed, from untransplanted plants, produces roots more partaking of the spindle form; whereas the seeds from the transplanted roots form thicker, and at the same time shorter, and on the lower parts roundishly terminated roots. The art of gardening affords numerous instances of the effect of this management. The seeds obtained from untransplanted lettuce yield, on being sown, plants which but extremely seldom form any heads, and never obtain any firmness. The seed of a loose and not transplanted cabbage never produces white cabbage, but a loose cole, not shooting into a head. The seed of celery, if procured not from a plant which, by transplantation, has been formed into a knob or nodule, but from celery which, for want of transplantation, has produced rather fibrous roots, yields on being sown only herb, and no nodules. I am convinced of the truth of these assertions from my own experiments, and appeal to what Luder and Germerhausen have written on this subject, as men whose science and accuracy will not be disputed.

14. "Among the spindle-shaped runkelruhes there exists a variety, as to their colour. Some have a pale-red rind, and are internally *quite white*, others with a rind usually of a more deep red, are internally *striped reddish*; others again, of a more or less deep red, have *red circles*; and lastly, there are some which, with an almost *white rind*, have the internal part *yellow*. Those which

which are white, with a light red rind, deserve the White Beet preference beyond all others: for they yield much sugar, and an agreeable sweet syrup; which, if well prepared, has no taste of the root.

15. "The red-striped or circled roots, whose rind also is always of a darker colour, afford sugar indeed, but the syrup is bad on account of its taste of the root, which cannot be removed, but by expensive chemical process. The runkelruhes of a white rind and yellow internal part do certainly afford much sugar, which shoots very readily into large crystals; but their syrup being of an extremely disgusting taste is of no use, when raw sugar only is made. Even the sugar itself prepared from these roots is not easily, but with difficulty, cleared of that taste in the condition of raw sugar, though it certainly disappears in refining. For this reason this last variety of the runkelruhe that contains so much sugar is not to be totally rejected, but is rather profitable in the manufactory of sugar: more especially, if not intended to be employed as raw sugar, and if the acquisition of the syrup be disregarded.

16. "It is sufficiently proved from the physiology of plants, that the *matter of light* has a great share in the formation of some of their constituent parts, as to quality, and consequently on their mutual proportions."

Mr Achard proceeds with the prolixity usual among German writers who leave nothing to be supplied by reflection, observation, or previous knowledge of their readers, to prove that the admission of light deprives the roots of vegetables of a saccharine quality, though it has a different effect upon fruits at the tops of trees or other plants. He remarks, that the roots of aspara-

White Beet. gus, hops, liquorice, and cucumber, are sweet while covered with earth, but on sprouting above ground, they acquire the peculiar sharp taste of the plant, and that carrots are always sweetest when sown between hemp and poppies, or when shaded by any other overhanging vegetables. He recapitulates the principles on which the new mode of cultivation proceeds in these terms :

Principles
of the new
culture.

“ In my method of cultivation, the ground is wholly covered with leaves, and consequently shaded by reason of the nearness of the plants to each other ; but, on the contrary, those roots which have been cultivated to feed cattle, are sown or planted at a much greater and usually double that distance. This very necessary adumbration is maintained by taking care not to cut the leaves till the roots themselves are gathered. The access of light to the surface of the field, to the great injury of the formation and accumulation of the saccharine matter in the root, is not the only bad consequence : there is another noxious effect ; namely, that it promotes the drying of the ground in hot seasons, which is always very detrimental. Moreover, the natural growth of the roots is, by this means, necessarily disturbed, and cannot be productive of good consequences. Again, if the earth be not removed from the plant, the action of light on the top of the root is checked ; and the separation of the ground, which is done in many places, tends only to increase the size of the root. Lastly, By producing the roots from seed, which has been sown in the spot where the plant is to remain, this advantage is obtained, that the root acquires a spindle-shape, penetrates deeper into the ground, and therefore acquires more sweetness ; for it is always sweeter in the lower than in the

the upper part. To conclude, the projection of one ^{White Beet.} part of the root out of the ground, which obtains in the growth of almost all roots, and especially of the runkel-ruhe, is by this method prevented. The cause of this prominence consists in this; that the earth, which it is impossible to avoid, is loosened on the spot where the plant is inserted. It sinks again on becoming firm, and hence the upper part of the root becomes prominent. Another, and the principal cause of this effect, arises from the circumstance that, on transplanting the plant, either the point of the root is taken off, or, on account of its tenderness, unintentionally injured; nor does it again acquire an upright position: so that, for all these reasons, it cannot proceed in growing downwards perpendicularly. Whence the root does not continue in the slender conical form which it had, and would have preserved, if it had not been transplanted: it then forms a more roundish and nodular root, which, in the progress of its vegetation (not being able to spread downwards from the too great resistance of the soil) rises upwards, and protuberates more or less from the earth in proportion to its stronger or weaker growth. Thus circumstanced, the prominent part becomes so modified in its constituent parts by the action of light, that it not only yields less of sugar, but also adulterates the saccharine matter, copiously contained in the lower part, with so many noxious principles, that the preparation of sugar from the root is rendered very difficult, and sometimes even impossible."

The mode of preparing the sugar is thus described: ^{Mode of preparing} "It is ascertained from the operation of extracting su-^{preparing} gar from the beet root, which I have performed under ^{sugar from} the beet. the inspection of a committee nominated by the king
of

White Beet. made from this muscovado of whatever quality is agreeable, and, by repeating it, the finest sugar may be had. The waste in this manufacture, that is to say, the residual pulp, the syrup or mucilage which passes through the cloth when subjected to the press, the syrup in which the sugar has crystallized, the washings, &c. all these are still very useful; and a considerable quantity of rum or brandy may be obtained from them, which may be used in making up the finest compounds. The muscovado, such as is obtained by the first operation, costs about a gros and a half of Prussia, without reckoning the matter which may be had by turning the residues to use. When we add this product, and when the manipulations shall be more perfect, to effect which I shall employ myself this winter, I am persuaded that our European muscovado will only cost half the price, or nine fennins; and in the countries where fuel is dearer, one gros (about 2½d) per pound avoirdupois. The manufacture of spirits from the waste of the sugar is of great importance, as by this means a great saving of corn will be made, and the manufacturing of beet-sugar, which delivers Europe from a destructive monopoly, becomes still more interesting. I am at present employed in the attempt to discover a method of pouring the juice of the roots, when sufficiently condensed, into moulds or forms in order that it may acquire the figure of a sugar-loaf, and afterwards by claying become very white at a single operation. I have already found several methods of obtaining this object very speedily. This new manipulation will facilitate the art of sugar-making, and diminish the price still further."

It is to be observed, that a committee of the class
of

of mathematical and physical sciences of the national ^{White Beet.} institute of France was appointed to repeat the experiments of Mr Achard on the sugar of the beet root. This committee began their experiments, by digesting a ^{French ex-} quantity of dried beet root in rectified spirit of wine, ^{periment.} which they afterwards decanted off. They next evaporated the spirit of wine, and thus obtained the sugar dissolved in it. This sugar amounted to one-sixteenth of the beet root that had been employed. They next boiled the beet root and expressed the juice, proceeding according to Mr Achard's directions. The result of their experiment was extremely unsuccessful, as they obtained only a very small quantity of sugar. They afterwards extracted the juice of the root in its raw state, and having evaporated this juice to the proper point, and kept it in a warm place for a month, they obtained a far larger quantity of sugar. The conclusion of the whole after many trials was, that, upon a large scale, they found that 32,400 square feet of ground cultivated with beet would produce 450 cwt. of the root. That this 450 cwt. of beet root would furnish about 782 pounds of muscovado sugar; which, by the process of refining, would be reduced to 448 lbs of pure sugar; and that on calculating the whole expences, this pure sugar could not be sold for less than 9d. per pound. Upon the whole, the committee considered Mr Achard's discovery as extremely important; but they considered the subject as not fully investigated, because the beet root on which their experiments were performed, had not been cultivated in Mr Achard's manner, but consisted only of such as could be purchased in the neighbourhood of Paris. It may also be remarked, that the French chemists do not appear to have attended to cer-
tain

White Beet. tain rules which Mr Achard represents as indispensable in the process of extracting the sugar. These rules are specially mentioned in a letter from Mr Achard to Professor Scherer, dated June 2. 1800. "The method which I have pursued is very simple, and attended with the least expence. The beet roots are washed, and cut down raw with the potato machine; after which they are boiled soft in spring water, 10 quarts being sufficient to boil a hundred weight of the roots. They are then pressed out hot from the pan, and the juice which they yield is immediately put, whilst hot, into the boiler, and boiled down to the consistence of inferior syrup. The crystallization succeeds extremely well, provided this boiling is performed in a short space of time: the juice may be condensed by the most violent boiling without suffering any injury, if only it is not continued for any considerable length of time; whilst, on the contrary, the most gentle boiling, if long continued, renders the juice unsusceptible of crystallization. The flatter, therefore, these boilers are, and the smaller the height of the column of liquid that is to be boiled down is, at first, the more certain we are of obtaining good crystallizable sugar. By following the method of pressing out the boiled roots whilst hot, and boiling down the hot juice immediately, one is secured from all the consequences of fermentation; and in order to prevent these from taking place, too great caution cannot be employed. In operations, ~~on~~ ^{at} a small scale, they may easily be prevented; but, in the ~~large~~ ^{large} way, ~~it~~ ^{it} will be far more difficult, unless we follow the above-mentioned method. A hundred weight of the first residue that remains, after the boiled roots have been pressed out, yields between seven and eight quarts of spirits, of equal

equal strength with the malt spirits usually fold, and is ^{White Beet.} therefore equal in value to half a bushel of wheat employed for this purpose. That the whole advantage resulting from the manufacture of sugar from the beet root depends entirely upon the manner of cultivation, and the choice of the best varieties of this plant, will again be proved, beyond all possibility of doubt, by the experiments made during the course of the present year, under the inspection of his Prussian majesty's commissioners."

We shall conclude these remarks by observing, that in the N^o for January 1800 of Mr Nicholson's Journal of Natural Philosophy, Chemistry, and Arts, published in London, the following information is given by the editor: "Mr Accam has presented me with samples of this sugar received from Berlin, where I understand it is now very commonly manufactured. The written account of the culture, produce, and cheapness, received at the same time, appearing to want some corrections, I shall only state at present, that the samples were, 1. A brown, or pale straw-coloured sugar, in lumps or agglutinated grains, forming a coarse dry powder. It is not very sweet, and has a peculiar, though not strong smell, which I think resembles that of some articles of confectionary consisting of sugar and flour heated or fried together. Of this sugar the beet is stated to afford five *per cent.* of its weight, leaving a pulp which is an excellent food for cattle. 2. A refined sugar, in very ~~small~~ ^{specimens} ~~crystalline~~ grains, forming a powder of which the particles are lightly disposed to adhere, and which, when laid upon writing paper, has very nearly the same whiteness. I could not ascertain the figure of any of the grains under a deep magnifier, as most of them seem

White Beet. to be partly rounded. It has no foreign smell or taste. Equal weights of this and of good loaf sugar were separately dissolved in equal weights of water; and ~~sent~~ out of seven gentlemen who were present, and tasted the solutions, without knowing which was the best sugar, determined, that the solution of this last was the sweetest. I was among those who thought so; but it appeared to me, that its flavour resembled a coarser sugar than that against which it was tried. From this notion I afterwards took two wine glasses of water, and sweetened the one with beet sugar, and the other with loaf sugar, with the addition of a small proportion of fine moist sugar. When the tastes resembled each other as nearly as I could bring them, I submitted them to the judgment of the company present, who, from the irregularity of their conjectures, did not seem to find any notable difference. And when I myself again took up the glasses, without noticing the distinctive marks, and endeavoured by the taste to determine which was the beet sugar, it happened that I was mistaken in my decision. This refined sugar seems therefore to be of considerable purity and strength. It is obtained from the other sugar in the quantity of 55 *per cent.* together with 25 *per cent.* of residual syrup or molasses. 3. The other article was a bottle of this molasses. It is sweet, with a singular vegetable flavour, rather fragrant; and would, I doubt not, afford either a pleasant vinous liquor by fermentation, or a considerable quantity of ardent spirit."

SECT. VIII.

CULTIVATION OF FRUIT.

IN Herefordshire and Gloucestershire the cultivation of fruit for the purpose of making a liquor from the juice, forms a principal part of their husbandry. In Devonshire also considerable quantities of this kind of liquor are made, though much less than in the two counties above mentioned.

The fruits cultivated in Herefordshire and Gloucestershire are, the apple, the pear, and the cherry. From the two first are made the liquors named *cyder* and *per-ry*; but though it is probable, that a liquor of some value might be made from cherries also, it does not appear to have ever been attempted. Mr Marshal remarks, that nature has furnished only one species of pears and apples; viz. the common crab of the woods and hedges, and the wild pear, which is likewise pretty common. The varieties of these fruits are entirely artificial, being produced not by seed, but by a certain mode of culture; whence it is the business of those who wish to improve fruits, therefore, to catch at superior accidental varieties; and having raised them by cultivation to the highest perfection of which they are capable, to keep them in that state by artificial propagation. Mr Marshal, however, observes, that it is impossible to make varieties of fruit altogether permanent, though their duration depends much upon management. "A time arrives (says he) when they can

Cultivation
of Fruit.

no longer be propagated with success. All the old fruits which raised the fame of the liquors of this country are now lost, or so far on the decline as to be deemed irrecoverable. The *red-streak* is given up; the celebrated *stir-apple*, is going off; and the *squash-pear*, which has probably furnished this country with more *champaign* than was ever imported into it, can no longer be got to flourish: the stocks canker, and are unproductive. In Yorkshire similar circumstances have taken place: several old fruits which were productive within my own recollection are lost; the stocks cankered, and the trees would no longer come to bear."

Our author controverts the common notion among orchard-men, that the decline of the old fruits is owing to a want of fresh grafts from abroad, particularly from Normandy, from whence it is supposed that apples were originally imported into this country. Mr Marshal, however, thinks, that these original kinds have been long since lost, and that the numerous varieties of which we are now possessed were raised from seed in this country. He also informs us, that at Ledbury he was shown a Normandy apple tree, which, with many others of the same kind, had been imported immediately from France. He found it, however, to be no other than the *bitter-sweet*, which he had seen growing as a neglected wilding in an English hedge.

Mr Marshal's directions for raising new varieties of fruit.

The process of raising new varieties of apples according to Mr Marshal, is simple and easy. "Elect (says he) among the native species individuals of the highest flavour; sow the seeds in a highly enriched seed-bed. When new varieties, or the improvement of old ones, are the objects, it may perhaps be eligible to use a frame or stove; but where the preservation of the ordinary

ordinary varieties only is wanted, an ordinary loamy soil will be sufficient. At any rate, it ought to be perfectly clean at least from root weeds, and should be double dug from a foot to 18 inches deep. The surface being levelled and raked fine, the seeds ought to be scattered on about an inch asunder, and covered about half an inch deep, with some of the finest mould previously raked off the bed for that purpose. During summer the young plants should be kept perfectly free from weeds, and may be taken up for transplantation the ensuing winter; or if not very thick in the seed-bed, they may remain in it till the second winter.

Cultivation
of Fruit.

The nursery ground ought also to be enriched, and double dug to the depth of 14 inches at least; though 18 or 20 are preferable. The seedling plants ought to be sorted agreeably to the strength of their roots, that they may rise evenly together. The top or downward roots should be taken off, and the longer side rootlets shortened. The young trees should then be planted in rows three feet asunder, and from 15 to 18 inches distant in the rows; taking care not to cramp the roots, but to lead them evenly and horizontally among the mould. If they be intended merely for stocks to be grafted, they may remain in this situation until they be large enough to be planted out; though in strict management, they ought to be re-transplanted two years before their being transferred into the orchard, "in fresh but unmanured double-dug ground, a quincunx ~~four feet~~ apart every way." In this second transplantation, as well as in the first, the branches of the root ought not to be left too long, but to be shortened in such a manner as to induce them to form a globular root, sufficiently small to be removed with the plant;

Of the
nursery
ground.

Cultivation of Fruit. yet sufficiently large to give it firmness and vigour in the plantation.

Method of choosing the plants. Having proceeded in this manner with the seed-bed, our author gives the following directions. "Select from among the seedlings the plants whose wood and leaves wear the most *apple-like* appearance. Transplant these into a rich deep soil in a genial situation, letting them remain in this nursery until they begin to bear. With the seeds of the fairest, richest, and best flavoured fruit repeat this process; and at the same time, or in due season, engraft the wood which produced this fruit on that of the richest, sweetest, best-flavoured apple: repeating this operation, and transferring the subject under improvement from one tree and sort to another, as richness, flavour, or firmness may require; continuing this double mode of improvement until the desired fruit be obtained. There has, no doubt, been a period when the improvement of the apple and pear was attended to in this country; and should not the same spirit of improvement revive, it is probable that the country will, in a course of years, be left destitute of valuable kinds of these two species of fruit; which, though they may, in some degree, be deemed objects of luxury, long custom seems to have ranked among the necessities of life."

The following mode of raising an orchard, together with the cyder fruits proper to be planted in it, is thus described, in a letter from the Rev. Charles Dunster to the earl of Egremont *. "The mode of propagating the cyder fruit is (I believe constantly in Herefordshire) by grafting.

* *Annals of Agriculture*, vol. xxxiii.

grafting. Very large and even old trees may be grafted, so as to bear very fine heads of other sorts, and come to bear a crop of fruit as quick or quicker than by any other method. Where new orchards are to be raised, it is done by planting well-grown crabstocks, and grafting them the year after. The mode of supplying you with Herefordshire cyder fruits must therefore be, if you have any orchards, the fruit of which you set no value on, they must be grafted next spring; and I will take care that you shall be supplied with grafts from Herefordshire.

Cultivation
of Fruit.

Mode of
raising cy-
der fruit.

“ I should observe to you, that if the trees are full-sized, the tops of them must be cut off in the winter, otherwise, when grafted, they will *bleed* (as the term is), so much that the grafts will not succeed. The trees must not be cut down to the trunk, but as many branches must be left as look kind, above where it branches out, of the thickness of one’s arm, or from that to twice as thick: the tops of these must be taken off about two or three feet from where they branch from the trunk. These stubs will each bear two or three, or even four grafts, according to their size.

“ I believe the skill of the grafter is material. The Herefordshire farmers are very superstitious in this respect; and a man who is considered as a *lucky* graft will have the chief of the business for many miles round; though the operation seems so simple that it might be imagined almost all men would be, in this respect, to use the language of the times, *equal*.

“ So much for grafting old orchards. For raising new ones, I could procure some good forward crabstocks to be sent in the beginning of March next, and planted immediately where they are meant to stand.

Cultivation of Fruit. These will cost, according to their goodness, from 4d. to 1s. 6s. and 2s. a piece. They will be fit for grafting the very latter end of March, or beginning of April, the following year. Of these you might have a hundred or two hundred; and if you wish in future to enlarge your cyder plantation, you should always be provided with crabstocks in your own nursery.

APPLES recommended, with their Qualities.

1. "*Forest Stire*—Famous stout cyder, and will grow from slips planted in the ground.
2. "*Cowarn Stire*—Recommended, and a kind growing tree.
3. "*Red Stire*—Stout round cyder.
- Old, 4. "*Redstreak*—Rich cyder; not propagated often with success; apt to canker.
- Old, 5. "*Woodcock*—Famous cyder; ditto, but grow some better; ditto.
- Old, 6. "*Golden Pippen*—Ditto, ditto, ditto.
- Old, 7. "*Red-sided Muske*—Ditto, ditto.
- Old, 8. "*Yellow Elliot*—Ditto, ditto.
- Old, 9. "*Old Porson*—Grows better than the above old fruits.
10. "*Royal Wilding*—Very rich cyder, and a fast-growing tree; mixes well with stout cyder.
11. "*Cowarn Quining*—A pleasant good cyder, and kind tree.
12. "*Red-sided Norman*—Rich cyder, and fast-growing tree, high coloured, and near in quality to the royal wilding.
13. "*Bennett Apple*—A very dry apple; stout good cyder, and a kind growing tree.

14. "*Garter Apple*—Recommended as famous, and making a good tree. Cultivation of Fruit.
15. "*Hagley Crab*—Stout famous cyder, and very growing tree.
16. "*Lawborne Pearmain*—Recommended, and makes a kind tree.
17. "*Hagley Crab*.

Recommended to graft on old heads; the royal wilding, the redsided norman, cowarn quining, hagley crab, cowarn fire, or the lawhorne pearmain.

"There came two parcels named *hagley crab*; one, viz. N^o 15. has yellow wood, most like a crab; the other, to which N^o 17. is put, has dark wood, more like an apple."

In the fourth volume of Bath Papers, Mr Grimwood supposes the degeneracy of apples to be rather imaginary than real. He says, that the evil complained of "is not a real decline in the quality of the fruit, but in the tree; owing either to want of health, the season, soil, mode of planting, or the stock they are grafted on, being too often raised from the seed of apples in the same place or county. I have not a doubt in my own mind, but that the trees which are grafted on the stocks raised from the apple pips are more tender than those grafted on the real crab-stock; and the seasons in this country have, for many years past, been unfavourable for fruits, which adds much to the supposed degeneracy of the apple. It is my opinion, that if planters of orchards would procure the trees grafted on real crab-stocks from a distant country, they would find their account in so doing much overbalance the extra expence of charge and carriage.

In the same volume, Mr Edmund Gillingwater af- Mr Gillingwater's opinion.
Y 4 signs

Cultivation of Fruit. signs as a reason for the degeneracy of apples the mixture of various farina, from the orchards being too near each other. In consequence of this notion, he also thinks, that the old and best kinds of apple trees are not lost, but only corrupted from being planted too near bad neighbours: "Remove them (says he) to a situation where they are not exposed to this inconvenience, and they will immediately recover their former excellency." This theory, however, is not supported by a single experiment.

Mr Samuel's opinion of the method of recovering the best fruit.

In this volume also Mr Richard Samuel expresses his concern at the "present neglect of orchards, where the old trees are decaying, without proper provision being made for the succeeding age: for if a farmer plants fresh trees (which does so frequently happen), there is seldom any care taken to propagate the better sorts, as his grafts are usually taken promiscuously from any ordinary kind most easily procured in the neighbourhood." His remedy is to collect grafts from the best trees; by which means he supposes that the superior kinds of fruit would soon be recovered. To a care of this kind he attributes the superiority of the fruit in the neighbourhood of great towns to that in other places.

Cultivation, &c, of fruit trees.

With regard to the method of cultivating fruit trees, it is only necessary to add, that while they remain in the nursery, the intervals betwixt them may be occupied by such kitchen-stuff as will not crowd or overshadow the plants; keeping the rows in the mean time perfectly free from weeds. In pruning them, the leader should be particularly attended to. If they shoot double, the weaker of the contending branches should be taken off; but if the leader be lost, and not easily recoverable,

recoverable, the plant should be cut down to within a hand's breadth of the soil, and a fresh stem trained. Cultivation
of Fruit.

The undermost boughs should be taken off by degrees, going over the plants every winter; but taking care to preserve heads of sufficient magnitude not to draw the stem up too tall, which would make them feeble in the lower part. The stems in Herefordshire are trained to six feet high; but our author prefers seven, or even half a rod in height. A tall-stemmed tree is much less injurious to what grows below it than a low-headed one, which is itself in danger of being hurt, at the same time that it hurts the crop under it. The thickness of the stem should be in proportion to its height; for which reason a tall stock ought to remain longer in the nursery than a low one. The usual size at which they are in Herefordshire is from four to six inches girth at three feet high; which size, with proper management, they will reach in seven or eight years. The price of these stocks in Herefordshire is 1s. 6d. each. Our author met with one instance of crabstocks being gathered in the woods with a good prospect of success.

In Herefordshire it is common to have the ground of the orchards in tillage, and in Gloucestershire in grass; which Mr Marshall supposes to be owing to the difference between the soil of the two counties; that of Herefordshire being generally arable, and Gloucestershire generally in grass land. Method of
managing
the ground
of orchards
in Here-
fordshire
and Glou-
cestershire. Trees, however, are very destructive, not only to a crop of corn, but to clover and turnips; though tillage is favourable to fruit trees in general, especially when young. In grass grounds their progress is comparatively slow, for want of the earth being stirred about them, and by being injured by the cattle, especially

Cultivation of Fruit. especially when low-headed and drooping. After they begin to bear, cattle ought by all means to be kept away from them, as they not only destroy all the fruit within their reach, but the fruit itself is dangerous to the cattle, being apt to stick in their throats and choak them. These inconveniences may be avoided, by eating the fruit grounds bare before the gathering season, and keeping the boughs out of the way of the cattle; but Mr Marshall is of opinion, that it is wrong to plant orchards in grass land. "Let them (says he) lay their old orchards to grass; and if they plant, break up their young orchards to arable. This will be changing the course of husbandry, and be at once beneficial to the land and the trees.

Indolence of the farmers in these parts complained of.

Our author complains very much of the indolent and careless method in which the Herefordshire and Gloucestershire farmers manage their orchards. The natural enemies of fruit trees (he says) are, 1. A redundancy of wood. 2. The mistletoe. 3. Mofs. 4. Spring frosts. 5. Blights. 6. Insects. 7. An excess of fruit. 8. Old age.

Excess of wood how remedied.

1. A redundancy of wood is prejudicial, by reason of the barren branches depriving those which bear fruit of the nourishment which ought to belong to them. A multitude of branches also gives the winds such an additional power over the tree, that it is in perpetual danger of being overthrown by them: trees are likewise thus injured by the damps and want of circulation of air, so that only the outer branches are capable of bringing fruit to maturity. "It is no uncommon sight (says he) to see trees in this district, with two or three tires of boughs pressing down hard upon one another, with their twigs so intimately interwoven, that even when

when the leaves are off, a small bird can scarcely creep in among them. Cultivation
of Fruit.

2. The mistletoe in this country is a great enemy to the apple tree. It is easily pulled out with hooks in frosty weather, when, being brittle, it readily breaks off from the branches. It likewise may be applied to a profitable purpose, sheep being as fond of it as of ivy. Mistletoe
how de-
stroyed.

3. Moss can only be got the better of by industry in clearing the trees of it; and in Kent there are people who make it their profession to do so. Moss on
fruit trees

4. Spring-frosts, especially when they suddenly succeed rain, are great enemies to fruit trees; dry frosts only keep back the blossoms for some time. Art can give no farther assistance in this case than to keep the trees in a healthy and vigorous state, so as to enable them to throw out a strength of bud and blossom; and by keeping them thin of wood, to give them an opportunity of drying quickly before the frost set in. Spring-
frosts.

5. Blight is a term, as applied to fruit trees, which Mr Marshall thinks is not understood. Two bearing years, he remarks, seldom come together; and he is of opinion, that it is the mere exhausting of the trees by the quantity of fruit which they have carried one year, that prevents them from bearing any the next. The only thing therefore that can be done in this case is, to keep the trees in as healthy and vigorous a state as possible. Blight is an
uncertain
term.

6. Insects destroy not only the blossoms and leaves, but some of them also the fruit, especially pears. In the year 1783 much fruit was destroyed by wasps. Mr Marshall advises to set a price upon the female wasps in the spring; by which these mischievous insects Method
proposed of
destroying
wasps.

Cultivation of Fruit. effects would perhaps be exterminated, or at least greatly lessened.

Of an excess of fruit.

7. An excess of fruit stunts the growth of young trees, and renders all in general barren for two or three years; while, in many cases, the branches are broken off by the weight of the fruit; and, in one case, Mr Marshall mentions, that an entire tree had sunk under its burden. To prevent as much as possible the bad effects of an excess of fruit, Mr Marshall recommends "to graft in the boughs," and when fully grown, to thin the bearing branches; thus endeavouring, like the gardener, to grow fruit every year."

Duration of fruit trees may be lengthened.

8. Though it is impossible to prevent the effects of old age, yet by proper management the natural life of fruit trees may be considerably protracted. The most eligible method is to graft stocks of the native crab in the boughs. The decline of the tree is preceded by a gradual decline of fruitfulness, which takes place long before the tree manifests any sign of decay. During this decline of fruitfulness, there is a certain period when the produce of a tree will no longer pay for the ground it occupies; and beyond this period it ought by no means to be allowed to stand. In the Vale of Gloucester, however, our author saw an instance of some healthy bearing apple trees, which then had the *second* tops to the same stems. The former tops having been worn out, were cut off, and the stumps saw-grafted. Our author observes, that the pear tree is much longer lived than the apple, and ought never to be planted in the same ground. He concludes with the following general observation: Thus considering fruit trees as a crop in husbandry, the general management appears to be this: Plant upon a recently broken-up

Mr Marshall's observation on the culture of fruit trees.

ken-up worn-out sward. Keep the soil under a state ^{Cultivation of Fruit.} of arable management, until the trees be well grown; then lay it down to graze, and let it remain in sward until the trees be removed, and their roots be decayed; when it will again require a course of arable management."

In consequence of an address of the house of commons, his majesty in 1791 granted a pecuniary reward ^{Forfyth's cure for diseases of trees.} to Mr William Forfyth for disclosing the following method of making and using a composition for curing diseases, defects, and injuries, in all kinds of fruit and forest trees. "Take one bushel of fresh cow-dung, half a bushel of lime rubbish of old buildings (that from the ceilings of rooms is preferable) half a bushel of wood-ashes, and a sixteenth part of a bushel of pit or river sand. The three last articles are to be sifted fine before they are mixed; then work them well together with a spade, and afterwards with a wooder beater, until the stuff is very smooth, like fine plaister used for the ceilings of rooms.

"The composition being thus made, care must be taken to prepare the tree properly for its application, by cutting away all the dead, decayed, and injured part, till you come to the fresh sound wood; leaving the surface of the wood very smooth, and rounding off the edges of the bark with a draw-knife or other instrument, perfectly smooth, which must be particularly attended to; then lay on the plaister about one-eighth of an inch thick all over the part where the wood or bark has been so cut away, finishing off the edges as thin as possible. Then take a quantity of dry powder of wood-ashes mixed with a sixth part of the same quantity of the ashes of burnt bones; put it into a tin-box, with holes in

**Cultivation
of Fruit.** in the top, and shake the powder on the surface of the plaister, till the whole is covered over with it, letting it remain for half an hour to absorb the moisture; then apply more powder, rubbing it gently, with the hand, and repeating the application of the powder till the whole plaister becomes a dry smooth surface.

“ All trees cut down near the ground should have the surface made quite smooth, rounding it off in a small degree as before mentioned; and the dry powder directed to be used afterwards should have an equal quantity of powder of alabaster mixed with it, in order the better to resist the dripping of trees and heavy rains.

“ If any of the composition be left for a future occasion, it should be kept in a tub or other vessel, and urine of any kind poured on it, so as to cover the surface, otherwise the atmosphere will greatly hurt the efficacy of the application.

“ Where lime rubbish of old buildings cannot be easily got, take powdered chalk or common lime, after having been flaked a month at least.

“ As the growth of the tree will gradually affect the plaister by raising up its edges next the bark, care should be taken, where that happens, to rub it over with the finger, when occasion may require (which is best done when moistened by rain), that the plaister may be kept whole to prevent the air and wet from penetrating into the wound.

“ The following is a more expeditious way of laying on the plaister. Take a quantity ready made, and mix up with urine or soap-suds to the consistency of thick paint, and lay on the wounds of the trees prepared for
its

its reception, with a painter's brush. The diseased part must be gone over a second time, as one coating is scarcely sufficient for large wounds, then proceed as above. Cultivation
of Fruit.

The following wash is said have proved very effectual in Nova Scotia in removing insects and moss from fruit trees. Wash from
removing
moss. The tendency of lime to destroy the moss plants is so great, that we account it worthy of general attention *. "Take a quantity of unslaked lime, mix it with as soft water as your situation will furnish, to the consistency of very thick white-wash; this mixture, with a soft paint-brush, apply to your apple trees as soon as you judge the sap begins to rise, and wash the stem and large boughs well with it, observing to have it done in dry weather, that it may adhere and withstand rain; you will find, that in the course of the ensuing summer, it will remove all moss and insects, and give to the bark a fresh green appearance; and that the tree will shoot much new and strong wood; at least it did so in Nova Scotia. The trial is simple, and can neither be attended with much expence, trouble, or danger."

* *Annals of Agriculture*, vol. XXXII.

Timber
Trees.

SECT. IX.

OF TIMBER TREES.

THE importance and value of these are so well known, that it is superfluous to say any thing on that subject at present: notwithstanding this acknowledged value, however, the growth of timber is so slow, and the returns for planting so distant, that it is generally supposed for a long time to be a positive loss, or at least to be attended with no profit. This matter, however, when properly considered, will appear in another light.

Different
kinds of
woodlands.

There are four distinct species of woodlands; viz. woods, timber groves, coppices, and woody wastes, The woods are a collection of timber trees and underwood; the timber groves contain timber trees without any underwood; and the coppices are collections of underwood alone. All these turn out to advantage sooner or later, according to the quick or slow growth of the trees, and the situation of the place with respect to certain local advantages. Thus in some places underwood is of great consequence, as for rails, hoops, stakes, fuel, &c. and by reason of the quickness of its growth it may be accounted the most profitable of all plantations. An osier-bed will yield a return of profit the second or third year, and a coppice in 15 or 20 years; while a plantation of oaks will not arrive at perfection in less than a century. This last period is so long, that it may not unreasonably be supposed likely to deter people from making plantations of this

What plan-
tation will
soonest
bring in a
return of
profit.

this kind, as few are willing to take any trouble for what they are never to see in perfection. It must be remembered, however, that though the trees themselves do not come to perfection in a shorter time, the value of the land will always increase in proportion to their age. Thus, says one author upon this subject, "we have some knowledge of a gentleman now living, who, during his lifetime, has made plantations, which, in all probability, will be worth to his son as much as his whole estate, handsome as it is. Supposing that those plantations have been made 50 or 60 years, and that in the course of 20 or 30 more they will be worth 50,000l; may we not say, that at present they are worth some 20,000l. or 30,000l.?" Mr Pavier, in the 4th volume of Bath Papers, computes the value of 50 acres of oak timber in 100 years to be 12,100l. which is nearly 50s. annually per acre; and if we consider that this is continually accumulating, without any of that expence or risk to which annual crops are subject, it is probable that timber planting may be accounted one of the most profitable articles in husbandry. Evelyn calculates the profit of 1000 acres of oak-land in 150 years, at no less than 670,000l.; but this is most probably an exaggeration. At any rate, however, it would be improper to occupy, especially with timber of such slow growth, the grounds which either in grass or corn can repay the trouble of cultivation with a good annual crop.

Timber
Trees.

Advantages of
planting.

In the fourth volume of the Bath Papers, Mr Wagstaffe recommends planting as an auxiliary to cultivation. He brings an instance of the success of Sir William Jerringham, who made trial of "the most unpromising ground perhaps that any successful planter has

Planting
meliorates
the soil.

Timber
Trees.

hitherto attempted." His method was to plant beech trees at proper distances among Scotch firs, upon otherwise barren heaths. "These trees (says Mr Wagstaffe), in a foil perhaps without clay or loam, with the heathy sod trenched into its broken strata of sand or gravel, under the protection of the firs, have laid hold, though slowly, of the foil; and, accelerated by the superior growth of the firs, have proportionally risen, until they wanted an enlargement of space for growth when the firs were cut down." He next proceeds to observe, that when the firs are felled, their roots decay in the ground; and thus furnish by that decay a new support to the foil on which the beeches grow: by which means the latter receive an additional vigour, as well as an enlargement of space and freer air; the firs themselves, though cut down before they arrived at their full growth, being also applicable to many valuable purposes.

Culture of
timber
trees re-
commen-
ded by Mr
Harries.

In the 6th volume of *Annals of Agriculture*, we find the culture of trees recommended by Mr Harries: and he informs us, that the larch is the quickest grower and the most valuable of all the resinous timber trees; but unless there be pretty good room allowed for the branches to stretch out on the lower part of the trunk, it will not arrive at any considerable size; and this observation, he says, holds good of all pyramidal trees. Scotch firs may be planted between them, and pulled out after they begin to obstruct the growth of the larch. Some of these larches he had seen planted about 30 years before, which at 5 feet distance from the ground, measured from 4 feet to 5 feet 6 inches in circumference. The most barren grounds, he says, would answer for these trees, but better foil is required for the
oaks.

oaks. In this paper he takes notice of the leaves of ^{Timber Trees.} one of his plantations of oaks having been almost entirely destroyed by insects; in consequence of which they did not increase in bulk as usual: but another which had nearly escaped these ravages, increased at an average one inch in circumference. "A tree four ^{Increase of} feet round (says he), that has timber twenty feet in ^{oak trees.} length, gains by this growth a solid foot of timber annually, worth one shilling at least, and pays 5 *per cent.* for standing. It increases more as the tree gets from five to six feet round. I have a reasonable hope to infer from my inquiry, that I have in my groves three thousand oaks that pay me one shilling each *per annum*, or 150*l.* a-year. My poplars have gained in circumference near two inches, and a Worcester and witch elm as much. I have lately been informed, that the smooth cut of a holly tree, that measures twenty inches and upwards round, is worth to the cabinet-makers 2*s.* 6*d.* per foot.

The following table shows the increase of trees in ^{Increase of} twenty-one years from their first planting. It was taken ^{trees in the} from the marquis of Lansdowne's plantation, begun ^{marquis} in the year 1765, and the calculation made on the ^{of Lanf-} 15th of July 1786. It is about six acres in extent; ^{downe's} the soil, partly a swampy meadow upon a gravelly ^{plantation.} bottom. The measures were taken at 5 feet above the surface of the ground; the small firs having been occasionally drawn for posts and rails, as well as rafters for cottages; and when peeled of the bark, will stand well for seven years.

Timber Trees.	Height in Feet.	Circumference in Feet. Inches.
Lombardy poplar	60 to 80	4 8
Arbeal	50 to 70	4
Plane	50 to 60	3 6
Acacia	50 to 60	2 4
Elm	40 to 60	3 6
Chefnut	30 to 50	2 9
Weymouth pines	30 to 50	2 5
Cluster ditto	30 to 50	2 5
Scotch fir	30 to 50	2 10
Spruce ditto	30 to 50	2 2
Larch	50 to 60	3 10

From this table it appears, that planting of timber trees, where the return can be waited for during a period of 20 years, will undoubtedly repay the original profits of planting, as well as the interest of the money laid out; which is the better worth the attention of a proprietor of land, as the ground on which they grow may be supposed good for very little else. From a comparative table of the growth of oak, ash, and elm timber, given in the 11th volume of the Annals of Agriculture, it appears that the oak is by much the slowest grower of the three.

Of under-
wood, &c.

With respect to the growth of underwood, which in some cases is very valuable, it is to be remarked, that in order to have an annual fall of it, the whole quantity of ground, whatever its extent may be, ought to be divided into annual sowings. The exact number of sowings must be regulated by the uses to which it is intended to be put. Thus if, as in Surrey, stakes, edders, and hoops are saleable, there ought to be eight or ten annual sowings; or, if, as in Kent, hop-poles

poles are demanded, 14 or 15 will be required; and if, as in Yorkshire, rails be wanted, or, as in Gloucestershire, cordwood be most marketable, 18 or 20 sowings will be necessary to produce a succession of annual falls. Thus the business, by being divided, will be rendered less burthenfome: a certain proportion being every year to be done, a regular set of hands will, in proper season, be employed; and by beginning upon a small scale, the errors of the first year will be corrected in the practice of the second, and those of the second in that of the third. The produce of the intervals will fall into regular course; and when the whole is completed, the falls will follow each other in regular succession. The greatest objection to this method of sowing woodlands is the extraordinary trouble in fencing: but this objection does not hold, if the sowings lie at a distance from one another; on the contrary, if they lie together, or in plots, the entire plot may be enclosed at once; and if it contain a number of sowings, some subdivisions will be necessary, and the annual sowings of these subdivisions may be fenced off with hurdles, or some other temporary contrivance; but if the adjoining land be kept under the plough, little temporary fencing will be necessary. It must be observed, however, that in raising a woodland from seeds, it is not only necessary to defend the young plants against cattle and sheep, but against hares and rabbits also; so that a close fence of some kind is absolutely necessary.

With regard to the preparation of the ground for raising timber, it may be observed, that if the soil be of a stiff clayey nature, it should receive a whole year's fallow, as for wheat; if light, a crop of turnips may

Timber
Trees.

Method of
sowing.

be taken; but at all events it must be made perfectly clean before the tree seeds be sown, particularly from perennial root weeds; as, after the seeds are sown, the opportunity of performing this necessary business is in a great measure lost. If the situation be moist, the soil should be gathered into wide lands, sufficiently round to let the water run off from the surface, but not high. The time of sowing is either the month of October or March; and the method as follows: "The land being in fine order, and the season favourable, the whole should be sown with corn or pulse adapted to the season of sowing; if in autumn, wheat or rye may be the crop; but, if in spring, beans or oats. Whichever of these three species be adapted, the quantity of seed ought to be less than usual, in order to give a free admission of air, and prevent the crop from lodging. The sowing of the grain being completed, that of the tree-seeds must be immediately set about. These are to be put in drills across the land: acorns and nuts should be dibbled in, but keys and berries scattered in trenches or drills drawn with the corner of a hoe, in the manner that gardeners sow their pease. The distance might be a quarter of a statute rod, or four feet and one inch and a half. A land-chain should be used in setting out the drills, as not being liable to be lengthened or shortened by the weather. It is readily divided into rods; and the quarters may be easily marked.

The species of underwood to be sown must be determined by the consumpt of it in the neighbourhood of the plantation. Thus if stakes, hoops, &c. be in request, the oak, hazel, and ash, are esteemed as underwood. When charcoal is wanted for iron
forges,

forges, beech is the prevailing underwood. The oak, ^{Timber Trees.} box, birch, &c. are all in request in different countries; and the choice must be determined by the prevailing demand. As the keys of the ash sometimes lie two or even three years in the ground, it will be proper to have the places where they are sown distinguished by some particular marks, to prevent them from being disturbed by the plough after harvest; as a few beans scattered along with them, if the crop be oats; or oats, if the crop be beans. The crop should be *reaped*, not *mown*, at harvest time, and be carried off as fast as possible. Between harvest and winter, a pair of furrows should be laid back to back in the middle of each interval, for meliorating the next year's crop, and laying the seedling plants dry; while the stubble of the unploughed ground on each side of the drills will keep them warm during winter. The next year's crop may be potatoes, cabbages, turnips: or if the first was corn, this may be beans; if the first was beans, this may be wheat drilled. In the spring of the third year the drills which rose the first year must be looked over, and the vacancies filled up from those parts which are thickest; but the drills of the ash should be let alone till the fourth year. The whole should afterwards be looked over from time to time; and this, with cultivating the intervals, and keeping the drills free from weeds, will be all that is necessary until the tops of the plants begin to interfere.

The crops may be continued for several years; and if they only pay for the expences, they will still be of considerable advantage by keeping the ground stirred, ^{Annual crops useful in plantations.} and preserving the plants from hares and rabbits. Even after the crops are discontinued, the ground

Timber Trees. ought still to be stirred, alternately throwing the mould to the roots of the plants, and gathering it into a ridge in the middle of the interval. The best method of doing this is to split the ground at the approach of winter in order to throw it up to the trees on both sides; this will preserve the roots from frost: gather it again in the spring, which will check the weeds, and give a fresh supply of air: split again at midsummer, to preserve the plants from drought: gather, if necessary, in autumn, and split as before at the approach of winter. The spring and midsummer ploughings should be continued as long as a plough can pass between the plants.

Whenever the oaks intended for timber are in danger of being drawn up too slender for their height, it will be necessary to cut off all the rest at the height of about an handbreadth above the ground; and those designed to stand must now be planted at about two rods distant from each other, and as nearly a quincunx as possible. The second cutting must be determined by the demand there is for the underwood; with only this proviso, that the timber stands be not too much crowded by it; for rather than this should be the case, the coppice should be cut, though the wood may not have reached its most profitable state. What is here said of the method of rearing oak trees in woods, is in a great measure applicable to that of raising other trees in timber groves. The species most usually raised in these are the ash, elm, beech, larch, spruce fir, Weymouth pine, poplar, willow, alder, chestnut, walnut, and cherry. The three last are used as substitutes for the oak and beech, and these two for the mahogany.

The

The following account of the mode of planting that <sup>Timber
Trees.</sup> was adopted by the earl of Fife, for no less than 550 acres of moorish lands, is worthy of attention. It is <sup>Earl of
Fife's plan.</sup> contained in a letter from his lordship to the publisher of the Annals of Agriculture, vol ix. "Where there are stones in the moor, I inclose with a stone wall five feet high, coped with two turfs, which cost about 15s. every Scots chain of 24 ells; and where there are no stones, which is mostly the case in the moors in the county of Murray, I inclose with a fence of turf, five feet high, four feet wide at the foundation, and 22 inches at top, at 4s. the Scots chain. I find these fences answer as well as the stone; for there are many of them, now above 20 years old, as good as at first. I plant in every acre about 1200 trees. I used to plant above 3000, but by experience I find it better not to plant them so thick, but make them up, if necessary, the third year (especially in my plantations in the county of Murray), where scarcely a tree planted ever fails. The greatest number of the trees are Scots firs raised by myself, or purchased at 10d. the thousand, planted from the seed-bed at three years old. I only considered them as nurseries to my other trees, for they are regularly cut out when they have done their duty as nurseries, and are profitable for fire, and useful in agriculture. I plant every other species of forest trees intermixed with the firs. I order different pieces of the moor to be trenched where the soil is best, and most sheltered, and lay a little lime and dung on it, and in these places I sow seeds of trees for nursery. I also plant in beds, year-old trees of different kinds, taken from my other nurseries. I nurse them for three years, and then plant them all over the plantation: this I find very beneficial,

Timber
Trees.

cial, as they are raised in the same soil. When I am filling up the plantations, the firs are, for the first time, cut down; or they are transplanted, being raised with balls of earth when the moor is wet with rain, which is very easily done, and they are carried to inclosures of ten or twelve acres, where, from a desire of forward woods, I am planting trees more advanced. They are planted in pits about 40 feet distance, and seldom or never fail, and answer a second time as nurseries.

“ My first care after the inclosure is properly filled up, is to guard against injury from cattle: a small allowance given to a few labourers answers that purpose, and if the fences are properly executed they require very little repair. After the plantation is filled up, the most regular attention must be had to the weeding of it, and this is carried on over my plantations of all ages in the most exact manner; I make roads through all the plantations which are carried forward according to the situation, never in a straight line so as to draw violent winds, and those roads go to all parts of the plantation; they make agreeable rides through fine woods, formerly a bleak moor, and answer not only for filling up, but also for carrying away the necessary weedings. As I observed before, the value and prosperity of the wood depends upon the unremitting attention in weeding it.

“ I begin to plant in October, and continue till April. If the weather is frosty and not fit for planting, all the people are employed in weeding the woods.”

The total want of growing timber upon a farm is frequently attended with much expence and inconvenience. It often deters an enterprising man from erecting

ing sheds, hogs-sties, cow-houses, &c. by which the live stock upon the farm might be increased, or the quantity of manure made upon it might be augmented.

Hence we are induced to call the attention of the reader to an experiment made by Mr Young in 1777 and the following years: At different times, during nine years, from that period, he planted about seven acres and a half, chiefly of very poor land; the principal trees were larches, Scotch and spruce firs, and Lombardy poplars, intermixed with some oaks, ashes, and elms. In 1799, that is to say, 22 years from the commencement of the experiment, the particulars of which we shall not detail; he speaks thus upon the subject*: “In the acre of 1777 the best larch are from two feet to two feet six inches in circumference, at five feet from the ground, and about 36 feet high; and in general varying from one foot to two. The best spruce are about two feet, and 32 high. The Scotch at five feet from the ground, not less in size, but not near so straight, tapering, or high. The best oaks from one foot five to one foot nine, and 20 high. The two acres of 1778, the best larch about two feet, and 30 high; in general from one to two feet. The spruce inferior; the Scotch still more so, and of a much less value. The oaks thriving and and very fair.

“The four acres, the best larch from one foot seven to two feet two. The Scotch, on an average, one foot seven, and 20 high: not equal to the spruce, and more inferior to the larch: the elms nothing.

“The Lombardy poplars in all the plantations.

Very

* *Annals of Agriculture*, vol. xxxiv.

Timber Trees. Very few of the black poplars are alive, and of no growth.

“ The half acre of 1787 are thriven greatly : in 12 years they form useful rails.

**Advantage
of a small
plantation.**

“ In regard to the return which these plantations have made me, when I began thinning long ago, I kept an account, but found the attention too much to do it accurately. I can, therefore, only speak in general, that, for these last seven or eight years, I have found the use of them incredibly great, even on this (for its size) very well timbered estate. They have furnished an immense quantity of posts, rails, spars, narrow slabs, boards, rafters ; and, in a word, every sort of consumption, by repairs and new buildings, sheds, sties, barns, stables, &c. and, as I have sold none, I have not yet got through the the first thinning of all, except where thriving oaks have demanded to be freed from their too near neighbours. The trees have suffered in size and value for want of earlier thinning ; but their thickness, in parts, has its convenience in furnishing rails, a moderate scantling, and good length. Whether the produce has equalled the annual expence of rent, &c. I am unable to ascertain ; but the convenience and agreeableness of this plenty of such articles make me well satisfied : and for the future I have no doubt of an immense value in the larger trees, when they come to be set out at proper distances, not to speak of oak, for future generations.

“ Had all been larch, instead of having planted any Scotch fir, the difference in the profit would have been immense. The chief use of the Scotch fir is for posts, as they thicken too much, and are too short for rails, in comparison with the other sorts.

“ Upon the whole, I am inclined to believe, that
there

there is no land on the estate of double the fertility that will pay equally with these seven and a half acres. Timber Trees.

“The conclusion, however, is not to be extended at this profit to planting on a very large scale; the great value results from having only this small quantity. If I had ten times as much land thus occupied, I must depend on felling; and then the market might be overstocked, and prices sunk greatly, with a difficulty, in some years of getting rid of them at all, whatever the profit might be in the end, by large scantlings always saleable; but for a few acres the benefit is so great, that no estate ought to be without such a resource.”

It is proper upon this subject to remark, that the value of large plantations of timber trees, as connected with other branches of agriculture, is not a little limited. In a mountainous country, and in bleak moorish situations, nothing tends more to increase the value of the soil, than plantations properly distributed. They give shelter both to the cattle and to the corn crops; and by preventing the warmth which is produced by proper manures, and by the germination of vegetables, from being dissipated, they give effect to all the efforts of industry. Accordingly, in such situations, plantations are no sooner reared, than the whole face of the country round them assumes an improving aspect, and displays a richer verdure. When suddenly cut down, in consequence of the necessities of an improvident proprietor, the reverse of all this occurs. Vegetation is chilled by the piercing blasts which now meet with no resistance, and the cattle droop from want of shelter; so that in a few years the place can scarcely be known. But the case is very different with regard to a rich and level country that is meant to be cultivated

Where plantations are eligible or otherwise.

Timber
Trees.

vated for corn. There the effect of numerous plantations, of high trees and lofty hedge rows, is altogether distressing to the husbandman. It is only in open fields that grain appears well ripened and completely filled. When surrounded with timber trees, on the contrary, it ripens ill, and is ill coloured and unequal. In spring the high shelter prevents the grounds from drying, and keeps back the labour. In summer the crop is liable to diseases from want of air, and is devoured by large flocks of small birds. In autumn, from want of a free circulation of air the corn ripens late, and in a weeping climate it can never be gathered in good condition. In wet seasons it is utterly ruined. In winter, when the snow is drifting about, the trees prepare a resting place for large quantities of it; these frequently remain and stop the spring work. Add to this, that in a low country even the cattle are hurt by the swarms of vermine that are bred, and come forth under the shelter of lofty trees and high fences.

Cattle pro-
per to be
employed.

PART III.

OF THE CATTLE PROPER TO BE EMPLOYED IN FARM
WORK; REARING AND MANAGEMENT OF THEM, OF
HOGS, POULTRY, &c. OF THE DAIRY. MAKING OF
FRUIT LIQUORS. OF FENCES.

SECT. I.

OF THE CATTLE PROPER TO BE EMPLOYED.

AS great part of the stock of a husbandman must al-
ways consist of cattle, and as one of his princi-
pal expences must consist of the maintenance of them,
this part of his business is certainly to be looked upon
as extremely important. The cattle belonging to a
farm may be divided into two classes, viz. such as are
intended for work, and such as are designed for sale.
The former are now principally horses; the oxen for-
merly employed being fallen into disuse, though it does
not yet certainly appear that the reasons for the ex-
change are satisfactory. In the second volume of Bath Mr Ke-
Papers, we have an account of a comparative experi-
ment of the utility of horses and oxen in husbandry by ^{dington's} experiment
Mr Keddington near Bury in Suffolk, in which the ^{on the com-}parative
preference is decisively given to oxen. He informs us, ^{utility of} horses and ^{oxen.}
that at the time he began the experiment (in 1779),
he was almost certain that there was not an ox worked

Cattle proper to be employed. in the whole county; finding, however, the expence of horses very great, he purchased a single pair of oxen, but found much difficulty in breaking them, as the workmen were so much prejudiced against them, that they would not take the proper pains. At last he met with a labourer who undertook the task; and the oxen "soon became as tractable and as handy, both at ploughing and carting, as any horses." On this he determined to part with all his cart-horses; and by the time he wrote his letter, which was in 1781, he had not a single horse, nor any more than six oxen: which inconsiderable number performed with ease all the work of his farm (consisting of upwards of 100 acres of arable land and 60 of pasture and wood), besides the statute duty on the highways, timber and corn carting, harrowing, rolling, and every part of rural business. They are constantly shod; their harness is the same as that of horses (excepting the necessary alterations for difference of size and shape); they are driven with bridles and bits in their mouths, answering to the same words of the ploughman and carter as horses will do. A single man holds the plough and drives a pair of oxen with reins: and our author informs us, that they will plough an acre of ground in less than eight hours time; he is of opinion that they could do it in seven. The intervals of a small plantation, in which the trees are set in rows ten feet asunder, are ploughed by a single ox with a light plough, and he is driven by the man that holds it. The oxen go in a cart either single, or one, two, or three, according to the load. Four oxen will draw 80 bushels of barley or oats in a waggon with ease; and if good of their kind, will travel as fast as horses with the same load.

load. One ox will draw 40 bushels in a light cart, which our author thinks is the best carriage of any. On the whole, he prefers oxen to horses for the following reasons. Cattle proper to be employed.

1. They are kept at much less expence, never eating meal or corn of any kind. In winter they are fed with straw, turnips, carrots, or cabbages; or, instead of the three last, they have each a peck of bran per day while kept constantly at work. In the spring they eat hay; and if working harder than usual in seed-time, they have bran besides. When the vetches are fit for mowing, they get them only in the stable. After the day's work in summer they have a small bundle of hay, and stand in the stable till they cool; after which they are turned into the pasture. Our author is of opinion, than an ox may be maintained in condition for the same constant work as a horse, for at least 4l. less annually. Reasons for preferring oxen to horses.

2. After a horse is seven years old, his value declines every year; and when lame, blind, or very old, he is scarce worth any thing; but an ox, in any of these situations, may be fatted, and sold for even more than the first purchase; and will always be fat sooner after work than before.

3. Oxen are less liable to diseases than horses.

4. Horses are frequently liable to be spoiled by servants riding them without their master's knowledge, which is not the case with oxen.

5. A general use of oxen would make beef plentiful, and consequently all other meat; which would be a national benefit.

Mr Kedington concludes his paper with acknowledging, that there is one inconvenience attending the use

Cattle proper to be employed. use of oxen, viz. that it is difficult to shoe them ; though even this, he thinks, is owing rather to the unskilfulness of the smiths who have not been accustomed to shoe these animals, than to any real difficulty. He confines them in a pound while the operation is performing.

Mr Marshall's calculations.

Mr Marshall, in his Rural Economy of the Midland Counties, shows the advantage of employing oxen in preference to horses, from the mere article of expence, which, according to his calculation, is enormous on the part of the horses. He begins with estimating the number of square miles contained in the kingdom of England ; and this he supposes to be 30,000 of cultivated ground. Supposing the work of husbandry to be done by horses only, and each square mile to employ 20 horses, which is about three to 100 acres, the whole number used throughout Britain would be 600,000 ; from which deducting one-sixth for the number of oxen employed at present, the number of horses just now employed will be 500,000. Admitting that each horse works ten years, the number of farm-horses which die annually are no fewer than 50,000 ; each of which requires full four years keep before he is fit for work. Horses indeed are broke in at three, some at two years old, but they are, or ought to be, indulged in keep and work till they are six ; so that the cost of rearing and keeping may be laid at full four ordinary years. For all this consumption of vegetable produce he returns not the community a single article of food, clothing, or commerce ; even his skin for economical purposes being barely worth the taking off. By working horses in the affairs of husbandry, therefore, "the community is losing annually the amount of

of 100,000 years keep of a growing horse;" which at the low estimate of five pounds a-year, amounts to a million annually. On the contrary, supposing the business of husbandry to be done solely by cattle, and admitting that oxen may be fattened with the same expenditure of vegetable produce as that which old horses require to fit them for full work, and that instead of 50,000 horses dying, 50,000 oxen, of no more than 52 stone each, are annually slaughtered; it is evident, that a quantity of beef nearly equal to what the city of London consumes would be annually brought into the market; or, in other words, 100,000 additional inhabitants might be supplied with one pound of animal food a-day each; and this without consuming one additional blade of grass. "I am far from expecting (says Mr Marshall), that cattle will, in a short space of time, become the universal beasts of draught in husbandry; nor will I contend, that under the present circumstances of the island they ought in strict propriety to be used. But I know that cattle, under proper management, and kept to a proper age, are equal to every work of husbandry, in most, if not all situations: And I am certain, that a much greater proportion than there is at present might be worked with considerable advantage, not to the community only, but to the owners and occupiers of lands. If only one of the 50,000 carcases now lost annually to the community could be reclaimed, the saving would be an object."

Cattle proper to be employed.
A million annually lost by keeping horses.

In Norfolk, our author informs us, that horses are the only beasts of labour; and that there is not perhaps one ox worked throughout the whole county. It is the same in the Vale of Gloucester, though oxen

No oxen used in Norfolk.

Cattle proper to be employed. are used in the adjoining counties. Formerly some oxen were worked in it double; but they were found

Objection to them in the Vale of Gloucester.

to poach the land too much, and were therefore given up. Even when worked single, the same objection is made: but, says Mr Marshal, "in this I suspect there is a spice of obstinacy in the old way, a want of a due portion of the spirit of improvement; a kind of indolence. It might not perhaps be too severe to say of the Vale farmers, that they would rather be eaten up by their horses than step out of the beaten track to avoid them." Shoeing oxen with whole shoes, in our author's opinion, might remedy the evil complained of; "but if not, let those (says he) who are advocates for oxen, calculate the comparative difference in *wear* and keep, and those who are their enemies estimate the comparative mischiefs of treading; and thus decide upon their value as beasts of labour in the

Used in the Cotswold.

Vale." In the Cotswold-oxen are worked as well as horses; but the latter, our author fears, are still in the proportion of two to one: he has the satisfaction to find, however, that the former are coming into more general use. They are worked in harness; the collar and harness being used as for horses, not reversed, as in most cases they are for oxen. "They appear (says our author) to be perfectly handy; and work, either at plough or cart, in a manner which shows, that although horses may be in some cases *convenient*, and in most cases *pleasurable to the driver*, they are by no means *necessary* to husbandry. A convenience used in this country is a moveable *harness-house* with a sledge bottom, which is drawn from place to place as occasion may require. Thus no labour is lost either by the oxen or their drivers.

Moveable harness-houses.

In Yorkshire oxen are still used, though in much fewer numbers than formerly; but our author does not imagine this to be any decisive argument against their utility. The Yorkshire plough was formerly of such an unwieldy construction, that four or six oxen, in yokes, led by two horses, were absolutely requisite to draw it; but the improvements in the construction of the plough have of late been so great, that two horses are found to be sufficient for the purpose; so that as Yorkshire has all along been famous for its breed of horses, we are not to wonder at the present disuse of oxen. Even in carriages they are now much disused; but Mr Marshall assigns as a reason for this, that the roads were formerly deep in winter, and soft to the hoof in summer; but now they are universally a causeway of hard limestones, which hurt the feet of oxen even when shod. Thus it even appears matter of surprise to our author that so many oxen are employed in this county; and the employment of them at all is to him a convincing argument of their utility as beasts of draught. The timber carriers still continue to use them, even though their employment be solely upon the road. They find them not only able to stand working every day, provided their feet do not fail them, but to bear long hours better than horses going in the same pasture. An ox in a good pasture soon fills his belly, and lies down to rest; but a horse can scarce satisfy his hunger in a short summer's night. Oxen are also considered as much superior at a difficult pull to horses; but this he is willing to suppose arises from their using half-bred hunters in Yorkshire, and not the true breed of cart horses. "But what (says he) are thorough-bred cart horses? Why, a species of strong,

Cattle proper to be employed.

Why the use of oxen is declining in Yorkshire.

Superiority of oxen to horses.

Cattle proper to be employed.

heavy, sluggish animals, adapted solely to the purpose of draught; and according to the present law of the country, cannot, without an annual expence, which nobody bestows upon them, be used for any other purpose. This species of beasts of draught cost at four years old from 20*l.* to 30*l.* They will, with extravagant keep, extraordinary care and attendance, and much good luck, continue to labour eight or ten years; and may then generally be sold for five shillings a-head. If we had no other species of animals adapted to the purposes of draught in the island, cart horses would be very valuable, they being much superior to the breed of saddle horses for the purpose of draught. But it appears evident, that were only a small share of the attention paid to the breeding of draught oxen which is now bestowed on the breeding of cart horses, animals equally powerful, more active, less costly, equally adapted to the purposes of husbandry if harnessed with equal judgment, less expensive in keep and attendance, much more durable, and infinitely more valuable after they have finished their labours, might be produced. A steer, like a colt, ought to be familiarized to harness at two or three years old, but should never be subjected to hard labour until he be five years old; from which age until he 15 or perhaps 20, he may be considered as in his prime, as a beast of draught. An ox which I worked several years in Surrey might at 17 or 18 years of age have challenged for strength, agility, and sagacity, the best bred cart horse in the kingdom.

Horses are every-where prevailing over oxen.

Notwithstanding all that has been said, however, and written, about the superiority of oxen to horses, the latter are still coming into more general use, especially

craily in proportion as the breed of horses improves; and we may add, in proportion as the state of cultivation in any part of the country improves. The reason is obvious. The horse is a more active animal than the ox, and can be turned with greater readiness from one kind of work to another. His hoof is less readily injured by the hardness of good roads; and for the use of the plough upon a well ordered farm, there is no comparison between the two kinds of animals. Where land is once brought into a proper state of tillage, it is easily turned over; and the value of the animal employed in doing so consists not so much in the possession of great strength as in the activity which he exerts in going over a great extent of ground in a short time. In this last respect, a good breed of horses so far surpasses every kind of oxen yet known in this country, that we suspect much the horse will still continue to be preferred by enterprising husbandmen.

Cattle proper to be employed.

With regard to the loss which the public is supposed to sustain by preferring horses to oxen, that point has of late been rendered, to say no more, extremely doubtful. In the Agricultural Survey of the county of Northumberland, we have the following comparative statement between horses and oxen, for the purpose of the draught;—"By way of preliminary, it will be necessary to admit as data, that a horse which eats 70 bushels of oats per year, will not consume of other food so much as an ox that gets no corn; but in the following estimate we shall allow horses to eat as much as oxen, as the difference is not yet sufficiently ascertained.

Calculations in favour of the use of horses.

"That the oxen are yoked at three years old, and are worked till six, and for the first year require eight

Cattle proper to be employed. to do the work of two horses; but after having been worked a year, and become tractable and stronger, six are equal to two horses, either by being yoked three at a time, or two, and driven by the holder with cords; of course, the expences of a driver may be estimated to be saved for one half the year.

“That the expences of a ploughman, the plough, and other articles that are the same in both teams, need not be taken into the account.

“And that oxen, to work regularly through the year, cannot work more than half a day at a time.”

Expence of an Ox per annum.

Summering.—Grass 2 acres at 20s. per acre - - L.

Wintering.—On straw and tur-

nips L. 2 0 0

But if on hay 4 0 0

The average is - - -

L. 5 0 0

Interest at 5 per cent. for price of the ox 0 10 0

Harness, shoeing, &c. - - 0 15 0

6 5 0

Deduct for the increased value of an ox

for 1 year - - - 1 0 0

Gives the expence *per annum* of an ox for

the team - - - 5 5 0

And the expence of 6 oxen - 31 10 0

To which must be added the expence of a

driver for half a year - - 3 10 0

Total expence of a team of 6 oxen L. 35 0 0

Ap

Cattle proper to be employed. " If a three horse-team be used, the account will stand thus :

The expence of a horse *per annum* being L. 15 15 0
3

That of three will be - - - 47 5 0
To which add the expence of a driver (8 0 0

Gives the expence of a three-horse team, L. 55 5 0

" If the comparison be made with the horse team of many of the midland counties, where they use *five horses yoked one before another in one plough*, the account will stand thus :

The expence of one horse *per annum* being - - - L. 15 15 0
5

That of five will be - - - 78 15 0
To which add the expence of a man to drive 18 0 0

The expence of a team of five horses will be - - - L. 96 15 0

Ditto - of 3 ditto 55 5 6
Ditto - of 2 ditto 31 10 0
Ditto - of 8 oxen 50 0 0

The average expence of an ox-team from three to six years old, that will do the same quantity of work as two horses , 40 0 0

" The conclusions to be drawn from the above statement, are so obvious as to need little elucidation. But we cannot help remarking, how strong the force of prejudice

judice must be, to continue the use of five horses, and heavy, clumsy, unwieldy *wheel-ploughs*, where a single *swing-plough* and two horses yoked double, and driven by the holder, would do the same quantity of work equally well, and at one half of the expence.”

Cattle pro-
per to be
employed.

“ But before any proper conclusion can be drawn, whether *ox teams* or *horse* are the most eligible, it will be necessary to consider, whether the quantity of land employed in supporting those animals, be used in the most profitable mode to the community, as well as to the occupier.

“ With the latter, the first question for consideration is, whether eight oxen used in the team or in grazing will pay him the most money ?

“ Suppose eight oxen, at *three years old*, were put to the plough, and plough six acres per week, which, at 3s. 4d. per acre, is 20s.; and if they work forty-eight weeks in a year, their whole earnings (after deducting 6l. for expences of harness, shoeing, &c.) will be 42l.; but if they plough only *five acres per week*, (which is probably nearer the truth), then their whole earnings will be only 34l.

“ The same oxen put to graze at the same money should improve in value 5l. 5s. each in the first case, and 4l. 5s. in the latter; but we are inclined to believe there are few situations, if the cattle are of a good quick-feeding kind, where they would not pay considerably more.

“ In respect to the community, the account will be nearly as follows :

“ From the above statements, we find that an ox for summering and wintering requires - $3\frac{1}{2}$ acres
Therefore

Cattle proper to be employed.	Therefore a six-ox team will require	-	2 $\frac{1}{2}$	acres
	And two horses for grafs and hay <i>per annum</i>			
	require	-	-	7 ditto.
	For corn and straw	-	-	4 ditto
	Land necessary for keeping two horses <i>per annum</i>	-	-	11 ditto

The difference in the quantity of land required for a team of oxen more than horses 10 ditto

“Hence it appears, that a team of six oxen requires ten acres more land to maintain them, than a team of two horses, which will do the same work; and of course the produce which might be derived from these ten acres is lost to the community. Suppose it be one half in grafs, the other half in tillage, then we shall have

“5 Acres of clover or grafs,
 1 $\frac{1}{2}$ Ditto of oats,
 1 $\frac{1}{2}$ Ditto of turnips or fallow,
 1 $\frac{1}{2}$ Ditto of wheat.

“It would then send to market yearly, at the lowest computation,

7 $\frac{1}{2}$ cwt. of beef,
 8 quarters of oats,

And 5 ditto of wheat.

“From this view of the subject, it appears that if oxen were universally used for the draught, in the room of horses, there would be a considerable defalcation, in the supply of the markets, both in corn and animal food. And the loss to the farmer would be the profit derived from the produce; which, by the usual mode of allowing one third for the farmer’s profit, would in this case be about 10l.”

SECT.

SECT. II.

OF THE DIFFERENT KINDS OF HORSES, AND THE METHOD OF BREEDING, REARING, AND FEEDING THEM.

THE midland counties of England have for some time been celebrated on account of their breed of the *black cart-horse*; though Mr Marshal is of opinion that this kind are unprofitable as beasts of draught in husbandry. The present improvement in the breed took its rise from six Zealand mares sent over by the late Lord Chesterfield during his embassy at the Hague. These mares being lodged at his lordship's seat at Bretby in Derbyshire, the breed of horses thus became improved in that county, and for some time it took the lead for the species of these animals. As the improved breed passed into Leicestershire, however, through some unknown circumstances, it became still more improved, and Leicester has for some time taken the lead. It has now been found, however, that the very large horses formerly bred in this district are much less useful than such as are of a smaller size. Mr Marshal describes, in magnificent terms, one of these large horses; a stallion belonging to Mr Bakewell, named K*, which, he says, was the handsomest horse he ever saw. "He was (says he) the fancied *war horse* of the German

Account of
the black
cart-horses.

Horses be-
longing to
Mr Bake-
well descri-
bed.

* Mr Bakewell distinguishes all his horses, bulls, and rams, by the letters of the alphabet.

Different
Kinds of
Horses.

German painters; who, in the luxuriance of imagination, never perhaps excelled the natural grandeur of this horse. A man of moderate size seemed to shrink behind his fore end, which rose so perfectly upright, his ears stood (as Mr Bakewell says, every horse's ears ought to stand) perpendicularly over his fore feet. It may be said, with little latitude, that in grandeur and symmetry of form, viewed as a pictureable object, he exceeded as far the horse which this superior breeder had the honour of showing to his majesty, and which was afterwards shown publicly at London, as that horse does the meanest of the breed." A more *useful* horse, bred also by Mr Bakewell, however, is described as having "a thick carcase, his back short and straight, and his legs short and clean; as strong as an ox, yet active as a poney; equally suitable for a cart or a lighter carriage."

Prices of
stallions.

The stallions in ~~this~~ county are bred either by farmers or by persons whose business it is to *breed* them, and who therefore have the name of *breeders*. These last either cover with themselves, or let them out to others for the season, or sell them altogether to stallion-men who travel about with them to different places.—The prices given for them are from 50 to 200 guineas by purchase; from 40 to 80 or a hundred by the season; or from half a guinea to two guineas by the mare. The mares are mostly kept by the farmers, and are worked until near the times of foaling, and moderately afterwards while they suckle: the best time for foaling is supposed to be the month of March or April; and the time of weaning that of November.—"The price of foals (says Mr Marshall), for the last ten years, has been from five to ten pounds

or

or guineas; for yearlings, 10 to 15 or 20; for two year-olds, 15 to 25 or 30; for six-year-olds, from 25 to 40 guineas."—Our author acknowledges that this breed of horses, considered abstractedly in the light in which they appear here, are evidently a profitable species of live stock, and as far as there is a market for six-years-old horses of this breed, it is profitable to agriculture. "But (says he) viewing the business of agriculture in general, not one occupier in ten can partake of the profit; and being kept in agriculture after they have reached that profitable age, they become indisputably one of its heaviest burdens. For besides a cessation of improvement of four or five guineas a-year, a decline in value of as much yearly takes place. Even the brood-mares, after they have passed that age, may, unless they be of a very superior quality, be deemed unprofitable to the farmer."

Different
Kinds of
Horses.

Mr Marshall's
observations
on breeding
horses.

Our author complains that this ancient breed of Norfolk horses is almost entirely worn out. They were small, brown-muzzled, and light boned; but they could endure very heavy work with little food; two of them were found quite equal to the plough in the soil of that county, which is not deep. The present breed is produced by a cross with the large one of Lincolnshire and Leicestershire already mentioned. He approves of the Suffolk breed, which (he says) are a "half-horse half-hog race of animals, but better adapted to the Norfolk husbandry than the Leicestershire breed: their principal fault, in his opinion, is a flatness of the rib.—In the Vale of Gloucester most farmers rear their own plough-horses, breeding of horses not being practised. They are of a very useful kind, the colour mostly black, inclinable to tan-colour, short and thick in

Norfolk
breed de-
scribed.

Suffolk and
Gloucester
breeds.

the

Different
Kinds of
Horses.

the barrel, and low on their legs. The price of a six-year-old horse from 25l. to 35l. Some cart-horses are bred in Cotswold hills; the mares are worked till the time of foaling, but not while they suckle; and the foals are weaned early, while there is plenty of grain upon the ground.

Yorkshire
horses.

Yorkshire, which has been long celebrated for its breed of horses, still stands foremost in that respect among the English counties. It is principally remarkable for the breed of saddle-horses which cannot be reared in Norfolk, though many attempts have been made for that purpose. Yorkshire stallions are frequently sent into Norfolk; but though the foals may be handsome when young, they lose their beauty when old. In Yorkshire, on the other hand, though the foal be ever so unpromising, it acquires beauty, strength, and activity as it grows up. Mr Marshal supposes that from five to ten thousand horses are annually bred up between the eastern Morelands and the Humber.

“Thirty years ago (says Mr Marshal), strong saddle-horses, fit for the road only, were bred in the Vale; but now the prevailing breed is the fashionable coach-horse, or a tall, strong, and over-sized hunter; and the shows of stallions in 1787 were flat and spiritless in comparison with those of 1783.” The black cart-horse, an object of Mr Marshal’s peculiar aversion, is also coming into the Vale.

In the breeding of horses he complains greatly of the negligence of the Yorkshire people, the mares being almost totally neglected; though in the brute creation almost every thing depends upon the female.

Lanarkshire
breed of
horses.

Of late years a very valuable breed of horses has been reared in the upper part of Clydesdale or Lanarkshire.

shire. They are of a middle size, well shaped, and extremely active. They are not fit for a very heavy draught; but the very quick step which they possess gives them a decided preference for the use of the plough upon well cultivated lands, as they are capable of going over an immense quantity of ground in a short time, where the draught is not severe. The same qualities render them highly useful for the ordinary purposes of farm-work. They are rapidly spreading over all parts of the country, and have found their way into the north of England, where they are greatly valued. In the same part of the country, a larger breed has also of late been encouraged, which adds very considerable strength or power to the activity of the former kind. They are in great request about Glasgow and other manufacturing towns. Their usual draught is a load of about 24 cwt. in addition to the cart on which the load is placed.

Different
Kinds of
Horses.

With regard to the general maintenance of horses, we have already mentioned several kinds of food upon which experiments have been made with a view to determine the most profitable mode of keeping them. Perhaps, however, the most certain method of ascertaining this matter is by observing the practice of those counties where horses are most in use. Mr Marshal recommends the Norfolk management of horses as the cheapest method of feeding them practised anywhere; which, however, he seems willing to ascribe in a great measure to the excellency of their breed. In the winter months, when little work is to be done, their only rack-meat is barley-straw; a reserve of clover-hay being usually made against the hurry of seed-time. A bushel of corn in the most busy season is computed to

Norfolk
manage-
ment of
horses re-
commend-
ed.

Different
Kinds of
Horses.

This method followed in many places in Scotland.

Calculations of the expence of keeping horses.

be an ample allowance for each horse, and in more leisure times a much less quantity suffices. Oats, and sometimes barley, when the latter is cheap and unsaleable, are given; but in this case the barley is generally malted, i. e. steeped and afterwards spread abroad for a few days, until it begin to vegetate, at which time it is given to the horses, when it is supposed to be less heating than in its natural state. Chaff is universally mixed with horse-corn: the great quantities of corn grown in this county afford, in general, a sufficiency of *natural chaff*; so that *cut chaff* is not much in use: the chaff, or rather the awns of barley, which in some places are thrown as useless to the dunghill, are here in good esteem as provender. Oat chaff is deservedly considered as being of much inferior quality.—It may here be remarked, that this method of keeping horses, which Mr Marshal approves of in the Norfolk farmers, is practised, and probably has been so from time immemorial, in many places of the north of Scotland; and is found abundantly sufficient to enable them to go through the labour required. In summer they are in Norfolk kept out all night, generally in clover leys, and in summer their keep is generally clover only, a few tares excepted.

In the fourth volume of the Annals of Agriculture, Mr Young gives an account of the expence of keeping horses; which, notwithstanding the vast numbers kept in the island, seems still to be very indeterminate, as the informations he received varied no less than from 8l. to 25l. a-year. From accounts kept on his own farm of the expence of horses kept for no other purpose than that of agriculture, he stated them as follows:

				<i>L.</i>	<i>s.</i>	<i>d.</i>	Different Kinds of Horses.
1763, Six horses cost per horse	-			10	13	0	<u> </u>
1764, Seven do.	-	-		8	10	11	
1765, Eight dō.	-	-	-	14	6	6	
1766, Six do.	-	-	-	12	18	9	
Average on the whole 11l. 12s. 3d.							

By accounts received from *Northminns* in Herefordshire, the expences stood as follows :

			<i>L.</i>	<i>s.</i>	<i>d.</i>
1768, Expence per horse	-		20	7	0
1769,	-	-	15	8	5
1770,	-	-	14	14	2
1771,	-	-	15	13	3
1772,	-	-	18	4	0
1773,	-	-	15	11	8
1774,	-	-	14	4	5
1775,	-	-	19	0	5
1776,	-	-	16	14	5
Average 16l. 13s. 1d.					

On these discordant accounts Mr Young observes, undoubtedly with justice, that many of the extra expences depend on the extravagance of the servants; while some of the apparent savings depend either on their carelessness, or *stealing* provender to their beasts privately, which will frequently be done. He concludes, however, as follows: "The more exactly the expence of horses is examined into, the more advantageous will the use of oxen be found. Every day's experience convinces me more and more of this. If horses kept for use alone, and not for show, have proved thus expensive to me, what must be the expence to those farmers who

Different
Kinds of
Horses.

Use of roots
for feeding
horses.

make their fat sleek teams an object of vanity? It is easier conceived than calculated.

It must be observed, however, that the above trials or accounts are of an old date; and that during the late dearth a variety of experiments were made, which shew that horses may be successfully fed, even when engaged in hard labour, with other articles than grain. With this view, different roots have been given them as substitutes; and a great saving has been experienced, attended with no loss of labour or disadvantage to the animal: so that the continuance and extension of this system is a matter of much importance to the public. The articles that have been chiefly employed are turnips, roota бага, potatoes, carrots, &c.—Turnips have been given in a raw state, withholding about one half of the usual allowance of corn, and in most instances the animals have done their work well, and appeared in good condition. When the roota бага has been used, little or no grain has been necessary, and the other roots already mentioned have been successfully used even in a raw state; but when potatoes, yams, roota бага, &c. are boiled, which has sometimes been done, it does not appear that grain is at all necessary. It is to be observed, that young horses eat these roots readily and with great relish; and that during the winter, with them and a small portion of dry food, they are kept in as good condition and spirit as when fed upon grass during the summer. This is a matter of much importance to young animals, as it must contribute greatly to their growth and future strength. Whereas, in a great majority of cases, when reared without the aid of these roots, they are fed in winter, when substantial food is most necessary to support them against the severity of the weather, in
such

such a manner as to be barely kept alive. During the winter months their growth is thus stopt; they lose the little flesh they had acquired during the preceding summer, become stunted and hide-bound, and, when the spring arrives, they are in so miserable a state, that a considerable part even of the summer elapses before they can resume their growth. In this way, four or five years are required to bring them to the size that others of the same species attain in half that time under different management.

Different
Kinds of
Horses.

In a letter to Mr Young, Mr George Culley expresses himself thus, with regard to the utility of potatoes as food for horses*. “I am happy to remark, that we have practised giving our work-horses potatoes for several years in the spring with the greatest success. I do not pretend to say, that we do not give corn to our horses at the same time, because it is a season that we work our horses remarkably hard. But we are inclined to think, that the giving potatoes along with their corn and straw (for we often have not hay at that season to spare), not only keeps them heartier, but prevents grease, which we used to be frequently accustomed to amongst our horses at that season. And we apprehend by those valuable roots keeping them cool, and open in their bodies, is the means of preventing grease, foulness, and many disorders, our horses used to be subject to. I am very sensible, that carrots are better for horses than potatoes; but then we can raise the latter at much less expence than the former, and they are more easily preserved in pits or stacks.”

Potatoes
for feeding
horses.

B b 3

Mr

* *Annals of Agriculture*, vol. xxi.

Different
Kinds of
Horses.

Carrots for
horses.

Mr Young also informs us *, that in France, in the neighbourhood of Brest, where they have a great pride in rearing fat horses ; they fatten numbers of them by feeding them with cabbages and parsnips boiled together, and mixed with buck-wheat flour, and given warm.

One uncommon excellence, said to attend the use of carrots in feeding horses † is this, that they are accounted a cure for broken-winded horses : by common work they do not seem to be at all affected ; and for those with only bad, or, as it is called, *thick* wind, they are an entire cure for the time they feed on them. Any green food in winter has a similar, though not an equal effect. It is observed abroad of chestnuts.

In addition to the use of roots, it is of importance to reduce the great expence of horse-keeping, in the opinion of Mr Young ‡, “ never to turn them out in summer, but to foil them constantly in the stable or yard with lucern, tares, or clover ; the first is by much the best, as it lasts through the six months, and yields very ample crops when well managed : in this method the crop, whatever it is, goes treble as far as when fed in the field ; and if the team is well littered, the dung-hill will almost pay the expence of their keeping. By this practice also the evil is avoided of feeding pastures and meadows with horses, which injure them more by their unequal feeding than many persons are aware of, but the ox improves the field.”

* *Travels*, vol. ii.

† *Annals of Agriculture*, vol. xxxvi.

‡ Vol. xxxvi.

SECT. III.

OF THE BREEDING AND REARING OF BLACK CATTLE.

THESE are reared for two different purposes; viz. A hornless work, and fattening for slaughter. For the former purpose, Mr Marshal remarks, that it is obviously necessary to procure a breed without horns. This he thinks would be no disadvantage, as *horn*, though formerly an article of some request, is now of very little value. The horns are quite useless to cattle in their domestic state, though nature has bestowed them upon them as weapons of defence in their wild state; and our author is of opinion, that it would be quite practicable to produce a hornless breed of black cattle as well as of sheep, which last has been done by attention and perseverance; and there are now many hornless breeds of these creatures in Britain. Nay, he insists, that there are already three or four breeds of hornless cattle in the island; or that there are many kinds of which numbers of individuals are hornless, and from these, by proper care and attention, a breed might be formed. The first step is to select females; and having observed their imperfections, to endeavour to correct them by a well chosen male.

The other properties of a perfect breed of black cattle for the purposes of the dairy as well as others, ought, according to Mr Marshal, to be as follow: Properties requisite in black cattle.

1. The head small and clean, to lessen the quantity of offal.
2. The neck thin and clean, to lighten the fore-

Breeding
and Rear-
ing of Black
Cattle.

end, as well as to lessen the collar, and make it fit close and easy to the animal in work. 3. The carcase large, the chest deep, and the bosom broad, with the ribs standing out full from the spine; to give strength of frame and constitution, and to admit of the intestines being lodged within the ribs. 4. The shoulders should be light of bone, and rounded off at the lower point, that the collar may be easy, but broad to give strength; and well covered with flesh for the greater ease of draught, as well as to furnish a desired point of fattening cattle. 5. The back ought to be wide and level throughout; the quarters long; the thighs thin, and standing narrow at the round bone; the udder large when full, but thin and loose when empty, to hold the greater quantity of milk; with large dug-veins to fill it, and long elastic teats for drawing it off with greater ease. 6. The legs (below the knee and hock) straight, and of a middle length; their bone, in general, light and clean from fleshiness, but with the joints and sinews of a moderate size, for the purposes of strength and activity. 7. The flesh ought to be mellow in the state of fleshiness, and firm in the state of fatness. 8. The hide mellow, and of a middle thickness, though in our author's opinion this is a point not yet well determined.

Properties
stated by
Mr Young.

Mr Young enumerates the properties of cattle intended for feeding, which do not seem to differ essentially from those already stated. "First, The beast should be short-legged. This is an important point in his shape, since few very short-legged ones will be, upon the whole, ill-made beasts.

"Next, The back should be very straight. In the best beasts, the backs are as straight as an arrow, without

out the least sinking or rising in any part ; and also very broad and very flat.

Breeding
and Rear-
ing of Cattle.

“ Thirdly, The carcase should be round, and as nearly the shape of a barrel as is consistent with one line, (the back) be ng quite straight.

“ Fourthly, The fore-quarters should, for the same reason, be round, full and spreading, in order that the fore end of the barrel may be as large as the hinder end

“ Fifthly, The neck and throat clean, with little or no dewlap.

“ These are some among many points. Mr Bakewell laid great stress on the merit of his breed fattening on the best joints, and exhibited an ox at London, whose rump was perfectly monstrous with fat, while the ordinary joints were by no means equally fat ; and, when we consider, that there is a difference of a penny and three half pence a pound in different joints, this certainly seems to be a sound doctrine.

“ A curled, instead of a straight-haired hide, is a sign of a thriving beast ; and in various instances of beasts that I have fattened myself, I have observed it to be a point of importance. They have remarked the same thing in Scotland. A lean beast also, with a curled hide, will generally keep himself in better order than another.”

It is to be observed, however, that a man would judge and act very unsafely, who in the purchase of cattle intended to be fattened should trust to his eye alone. A still more important object perhaps is, that the skin, when handled, should feel soft and silky ; hence, in choosing cattle, with a view to convert their food into the largest sum of money per ton, a very principal

Breeding
and Rear-
ing of Black
Cattle.

cipal share of attention ought to be given to the feel or touch. The opinion upon this subject of Mr George Culley is the result of extensive practice and accurate observation. He recommends cattle whose skins feel soft or mellow: He also says, "indeed it is the nice touch or feel of the hand which, in a great measure, constitutes the judge of cattle.

Mr Young observes, that "heifers spayed in general fatten better and quicker than oxen, but they are not to be had with equal certainty.

"Dry and old cows are fattened in some places in great numbers; but the risk of all sorts is greater; so that, notwithstanding their being sometimes very profitable, oxen are to be preferred. Cows should take the bull before they are fattened, but they should be fat three months before the time of calving.

"Oxen that have been worked are preferred all over England by the graziers: they not only fat kindlier than others, but make the best beef. Mr Middleton of Suffolk killed an ox that worked even till fourteen years old, and the beef proved excellent. This is a manifest proof of the benefit of working, since we are told that sixteen years is the common life of an ox.

Food for
cattle.

Concerning the proper food of cattle, we account it unnecessary to make any remarks in addition to those already stated in different parts of our work. It may be proper to observe, however, that every farmer or grazer who wishes to conduct his business to advantage, ought so to arrange his affairs, and the stock of food that he provides for his cattle, as to have it in his power to keep them on hand during the winter, and to sell them when meat sells dearest; that is, from the first of March to the first of June. At this period he will
not

not only obtain a better price than in autumn, but his stock will go off freely, and every change of markets will be in his favour. He will also obtain the largest possible command of manure. In accomplishing this object the great difficulty consists of providing a sufficient store of winter food. Upon the quantities of such food necessary for fattening cattle, we shall take notice of some remarks made by Mr Young *.

Breeding
and Rear-
ing of Black
Cattle.

“ 1. *Oil-cake*.—There is no article in the food of an ox which has hitherto been found to equal this in the fattening quality.

“ It is the cake of linseed, not rape. While beef sells at 4d. a pound, and the cake is to be bought at 4l. per ton, there is a considerable profit to be made by using it, supposing the price of the animal lean is upon the par of good times. But this food has risen of late years to so high a price, that no other benefit can be made by using it than what arises from the dung.

“ It is to be noted, that whatever food is used principally, yet that hay is always to be supposed; for whether oil-cake, cabbage, or roots, be the food, it has been found profitable to allow the beast from half a stone to a stone of hay *per diem*. Mr Moody of Retford in Nottinghamshire gives a beast of a hundred stone two cakes a day, each 6lb. for the first two months, and then three a day till fat.

In November and December 120 cakes

To end of March ‘ 270

390 at 6lb. is 21 cwt.

21 cwt.

Breeding and Rearing of Black Cattle.	21 cwt. at 4l. 10s. per ton is	-	L. 4 14 6
	20lb. hay per day, 1 ton 6. cwt. at 40s.		2 12 0

To winter fattening such a beast - 7 6 6

"On the same principle as cake-feeding, some persons have tried, and it is said with success, linseed oil (at 3s. 6d. a gallon) and bran. For small cattle two pecks each of bran a day, divided into three feeds, and into each peck half a pint of oil well mixed. Also mixtures of bran, malt combs, and pease or other meal; but all these foods must depend on price.

"Oil-cakes for this purpose have also been boiled, it is said with success.

"2. *Carrots*.—Next to oil-cake this root fattens an ox better than any other food; still, however, he must be allowed a portion of good hay in addition. Of this sort of root, an ox will eat something better than a seventh of his own weight every day—suppose we say a sixth; consequently a beast of 60 stone will eat 10 stone of carrots; and as an acre will yield 400 bushels or 22,400lb. it would support such an ox 160 days or between five and sixth months; a period too long for beasts to be kept that have had the summer's grass. If they are half fat, when put to carrots, an acre would fatten two such beasts.

"3. *Cabbages*, for this purpose, are also an admirable plant; from many experiments made by various gentlemen of acknowledged accuracy, it has been found, that an ox will eat something less *per diem* than a fifth of his own weight.

"4. *Turnips*, though the most common article of winter food, are inferior to any of the preceding: they are much more liable to accidents and distempers,

and consequently can be little depended on; nor have they the fattening quality in an equal degree. A beast will eat from a third to half his own weight of these every day: an acre of 25 tons will therefore fatten a beast of 60 stone or something more. There is no occasion to slice them.”

Breeding
and Rear-
ing of Black
Cattle

The same writer takes notice of some of the more ordinary diseases to which cattle are liable, the remedies for which ought to be generally known.

Diseases of
cattle.

“The *garget*.—This disease is an obstruction in the bag, owing to not being clean milked: an internal tumour grows into a hard knot, and it is commonly attended with the loss of one or two teats, and sometimes more. When a cow is infested with it, she should be dried for fattening, which is better than attempting the cure of a disease which, of any standing, is incurable. Great care and attention should, therefore, be used to have the milkers do their business clean. Cows that are suckled are much less liable to this distemper than those that are milked: and when first they are attacked with it, a good way is to have the cow suckled for some time, stroking clean after the calf.

“*The fever*.—Whether the disease, which the farmers term a fever, is really one, I do not know; but should much question it from the warmth of the cordials given, and with success. It deserves rather to be called a *cold*, and usually proceeds from catching cold in, or soon after, calving. I have given Brackin’s cordial ball, dissolved in a pint of warm ale, with success. The cow should be confined, and have only hay and warm water, with a warm malt mash at night.

“*Looseness*.—Give salt and powdered chalk in equal quantities;

Breeding quantities; a large spoonful of the mixture twice a day, and Rearing of Black Cattle. and keep her to dry meat.

“*Hoving*, or swelling from eating very succulent plants, particularly clover. One remedy is to drive them very severely about, and dose them with salt and water pretty strong, half a pint or a pint at a time. Stabbing is a much more effectual cure with those who have had experience enough to practise it. A lancet-pointed knife, with a haft that prevents its entering more than four inches into the paunch should be kept in readiness. The blow is given exactly between the short ribs and hip-bone.”

As this last frequently occurs, and is attended with very fatal consequences, we shall here state some other remedies. A correspondent of Mr Young, partly upon Dr Monro's cure for swelled cattle. authority of a work entitled *Rawlin's Cow-Doctor*, and partly upon his own authority, makes the following remarks *: “As many black cattle are lost in consequence of the swelling occasioned by their having eaten red clover and other soft and succulent grafs, potatoes, grain, oil-cakes, &c. the celebrated Dr Monro, professor of anatomy in Edinburgh, invented a flexible tube for the sole purpose of remedying this violent and dangerous disease, with the greatest safety, ease, and despatch; which invention he has for many years mentioned in the course of his Anatomical Lectures; but, from its not being generally known, the advantages which would immediately arise from it, are lost to the greatest part of the community, to whom it might be of service.

“Dr

* *Annals of Agriculture*, vol. xxix.

“ Dr Monro begins by observing, that the swelling of the belly is owing to the distension of the stomachs, and particularly of the first stomach, by fixed air, which is disengaged from the tender and succulent grass, &c. in consequence of its solution and violent fermentation; while the discharge of it afterwards through the gullet seems to be prevented by a spasm, or muscular contraction of the upper orifice of the stomach. He next remarks, that the dangerous and often fatal effects, which follow the distension, are not owing to the fixed air nor to the juices of the fermented grass, acting as poisonous upon the stomach, as a moderate quantity of either produces no bad effects; and that the repeated experience of the grazier has shown, that many cattle are immediately relieved and preserved by stabbing them with a knife, and thus allowing the air to escape. He therefore concludes, that cattle may with certainty be saved, if the air be drawn off in due time, without injuring the stomach or other bowels; and he affirms, that this may be done with great ease, by passing a flexible tube from the mouth down the gullet into the stomach.

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ing of Black
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“ The tube is to be composed of iron wire, of about one-sixteenth of an inch diameter, twisted round a smooth iron rod three-eighths of an inch diameter, in order to give it the cylindrical form; and, after taking it off the rod, it is to be covered with smooth leather. To the end of the tube, which is intended to be passed into the stomach, a brass pipe two inches long, of the same size, or something larger than the tube, and pierced with a number of large holes, is to be firmly connected. To prevent the tube from bending too much within the mouth or gullet in the time of passing it down into the stomach,

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stomach, an iron wire, one-eighth of an inch diameter, and of the same length as the tube, is put within it, which is to be withdrawn when the tube has entered the stomach. He has found that the space from the fore-teeth to the bottom of the first stomach of a large ox measures about six feet: and he has passed such a tube, five feet nine inches long, into the gullet of a living ox. The tube ought therefore, to be six feet long, that we may be sure of its answering in the largest ox.

“ After the tube is passed into the stomach, it may be allowed to remain for any length of time, as it does not interrupt the breathing of the animal. The greater part of the elastic and condensed air will be readily discharged through the tube; and, if it be thought necessary, ardent spirits, or any other fluid fit for checking fermentation, or which may be useful in other respects, can be injected through such a tube into the stomach.

“ By means of such a tube the air is not only more certainly discharged than by stabbing the animal; but the danger is avoided, which the stabbing occasions, not so much by the irritation which the wound creates, as that the air and the other contents of the stomach, getting into the cavity of the belly between the containing parts and the bowels, excite such a degree of inflammation as frequently proves fatal to the animal.

“ This flexible tube has been found of infinite service in saving the lives of sheep when attacked by similar disorders, or any other swelling peculiar to that animal.

“ The instrument above described is so simple and easy

easy to make, that I should imagine any common work-
man would be equal to the undertaking. Mine was <sup>Breeding and Feed-
ing of Black Cattle.</sup> made by James M'Dowal, N^o 15. Great Windmill-street,
London, who is a very ingenious mechanic in every
thing relating to agriculture."

In the same work the following remedy is stated, upon <sup>Another
cure for
swelled
cattle.</sup> the authority of an anonymous correspondent. "Three
quarters of a pint of olive oil; one pint of melted but-
ter or hogs-lard: Give it to the beast with a horn or bot-
tle; and, if not better in a quarter of an hour, repeat
the same quantity. Walk the animal gently about.—
The dose for a sheep, a wine-glass and half to two
glasses.

"The effects of this simple medicine are hardly to be
conceived till tried. The first dose generally performs
a cure, which is perceived almost as soon as the animal
has swallowed it, by its breaking wind, and the subsid-
ing of its sides."

A still simpler remedy than any of these is now used <sup>A simpler
remedy.</sup> in some parts of the country, with such entire success,
that it ought to be generally known. It consists of fill-
ing an egg-shell with tar, and immediately putting it
down the throat of the animal. The stimulating effect
of the tar immediately removes the spasms that appear
to affect the upper and lower orifices of the stomach of
the animal.

For the cure of what are called the *dry murrain* and <sup>Dry mur-
rain.</sup> *bloody urine*, the following remedies, which appear to be
judicious, are stated as successful by an anonymous wri-
ter in the Farmers Magazine. "I have frequently given
to cattle, labouring under the first of these disorders,
large quantities of boiled turnips mixed with butter, cas-
tor oil, and other powerful laxative medicines, and also
some

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and Feed-
ing of Black
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some injections, without being able to produce the desired effect. After having employed several cow-doctors, and losing several beasts by this severe disorder, I determined (after having in vain given at the mouth considerable quantities of the above laxatives), to give the under-mentioned strong injection, which, in the course of six or eight hours, produced a very copious discharge of dung. Apprehending danger from the greatness of the discharge, I used grated wheaten bread boiled in water, and water and wheat-meal boiled together; which, in the course of a few days, sufficiently checked the discharge. During the illness, the beast should be kept moderately warm, and have warm water, and afterwards *oat-meal* and *water* for several days. I have found that cattle are least subject to this disorder, when some turnips are given with their fodder. The injection I used was three pints of common gruel, four ounces of Epsom salts, half a gill of tincture of senna, and half a gill of olive oil well mixed. Laxative medicines given at the mouth, and bleeding to prevent inflammation, are also necessary. If the first glyster does not produce the desired effect, a repetition of it will seldom fail to effect a cure.

Bloody
urine.

In the *bloody urine*, adds this author, I never, except in one instance, when the delay was too long, knew the following method prove abortive. As soon as the bloody urine is observed, the animal should be housed; immediately afterwards let a pint of common sea-salt be dissolved in cold water (as much as is necessary to hold it in solution); and given at the mouth. A few hours afterwards the animal will have a great inclination to drink, and large quantities of clear cold water should be offered. If it will not voluntarily drink a great ¹⁰/₁₀ considerable

considerable quantities should from time to time be administered by force, till the urine turn to its natural colour, which it will generally do in the course of 24 to 30 hours. Instead of the salt and water, I have, with equal success, used about a gallon of milk well strained, after a considerable quantity of old rusty iron had been heated red-hot, and put into it. If the quantity of iron be sufficient, the thirst will be very great, which should be satisfied as above. I apprehend, that in this disorder the greatest danger proceeds from excessive heat or fever, bringing a kind of murrain or stoppage of dung, provincially "the feather cling." To obviate or remove this, I have always found, that a few ounces of Locatelle's balsam, given at the mouth, is effectual. It generally takes place within a day or two after the other disorder ceases."

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and Feed-
ing of Black
Cattle.

As the milk of cows is always an article of great importance, it becomes an object to the husbandman, if possible, to prevent the waste of that useful fluid, which, in the common way of rearing calves, is unavoidable. A method of bringing up these young animals at less expence was at one time proposed by the duke of Northumberland. His plan was to make skimmed milk answer the purpose of that which is newly drawn from the teat; and which, he supposed, might answer the purpose at one-third of the expence of new milk*. The articles to be added to the skimmed milk are treacle and the common linseed oil-cake ground very fine, and almost to an impalpable powder, the quantities of each being so small, that to make 32 gallons would cost only

Of rearing
calves with
out milk.

C c 2

6d.

* *Annals of Agriculture*, vol. i. p. 296.

Breeding and Feeding of Black Cattle. 6d. besides the skimmed milk. It mixes very readily and almost intimately with the milk, making it more rich and mucilaginous, without giving it any disagreeable taste. The receipt for making it is as follows: Take one gallon of skimmed milk, and to about a pint of it add half an ounce of treacle, stirring it until it is well mixed; then take one ounce of linseed oil-cake finely pulverized, and with the hand let it fall gradually in very small quantities into the milk, stirring it in the mean time with a spoon or ladle until it be thoroughly incorporated; then let the mixture be put into the other part of the milk, and the whole be made nearly as warm as new milk when it is first taken from the cow, and in that state it is fit for use. The quantity of the oil-cake powder may be increased from time to time as occasion requires, and as the calf becomes inured to its flavour.

Mr Young's experiments.

On this subject Mr Young remarks, that in rearing calves, there are two objects of great importance: 1. To bring them up without any milk at all; and, 2. To make skimmed milk answer the purpose of such as is newly milked or sucked from the cow. In consequence of premiums offered by the London Society, many attempts have been made to accomplish these desirable purposes; and Mr Budel of Wanborough in Surrey was rewarded for an account of his method. This was no other than to give the creatures a gruel made of ground barley and oats. Mr Young, however, who tried this method with two calves, assures us, that both of them died; though he afterwards put them upon milk when they were found not to thrive. When in Ireland he had an opportunity of purchasing calves at three days old from 20d. to 3s. each; by which he was induced

to repeat the experiment many times over. This he did in different ways, having collected various receipts. In consequence of these he tried hay-tea, bean-meal mixed with wheat-flour, barley and oats ground nearly, but not exactly, in Mr Budd's method: but the principal one was flax-seed boiled into a jelly, and mixed with warm water; this being recommended more than all the rest. The result of all these trials was, that out of 30 calves only three or four were reared; these few were brought up with barley and oat-meal and a very small quantity of flax-seed jelly, one only excepted, which, at the desire of his coachman, was brought up on a mixture of two thirds of skimmed milk and one-third of water, with a small addition of flax-jelly well dissolved.

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and Feed-
ing of Black
Cattle.

The second object, viz. that of improving skimmed milk, according to the plan of the duke of Northumberland, seems to be the more practicable of the two. Mr Young informs us, that it has answered well with him for two seasons; and two farmers to whom he communicated it gave likewise a favourable report.

In the third volume of the same work, we are informed, that the Cornwall farmers use the following method in rearing their calves. "They are taken from the cow from the fourth to the sixth day; after which they have raw milk from six to ten or fourteen days. After this, they feed them with scalded skimmed milk and gruel made of shelled oats, from three quarts to four being given in the morning, and the same in the evening. The common family broth is thought to be as good, or better, than the gruel, the flavour of the salt being supposed to strengthen their bowels. The propor-

Method of
rearing
calves in
Cornwall.

Breeding and Feeding of Black Cattle. tion of gruel or broth is about one-third of the milk given them. A little fine hay is set before them, which they soon begin to eat.

Mr Crook's method.

In the 5th volume of Bath Papers, we have an account by Mr Crook of a remarkably successful experiment on rearing calves without any milk at all. This gentleman, in 1787, weaned 17 calves; in 1788, 23; and in 1789, 15. In 1787, he bought three sacks of linseed, value 2l. 5s. which lasted the whole three years. One quart of it was put to six quarts of water; which, by boiling 10 minutes, was reduced to a jelly: the calves were fed with this, mixed with a small quantity of tea, made by steeping the best hay in boiling water. By the use of this food three times a-day, he says, that his calves throve better than those of his neighbours, which were reared with milk. These unnatural kinds of food, however, are in many cases apt to produce a looseness, which in the end proves fatal to the calves. In Cornwall, they remedy this sometimes by giving acorns as an astringent; sometimes by a cordial used for the human species, of which opium is the basis.

Norfolk method, &c.

In Norfolk, the calves are reared with milk and turnips; sometimes with oats and bran mixed among the latter. Winter calves are allowed more milk than summer ones; but they are universally allowed new milk, or even to suck. In the midland counties bull-calves are allowed to remain at the dam until they be six, nine, or twelve months old, letting them run either with their dams or with cows of less value bought on purpose. Each cow is generally allowed one male or two female calves. Thus they grow very fast, and become surprisingly vigorous. The method of the dairy-

men

men is to let the calves suck for a week or a fortnight, according to their strength; next they have new milk in pails for a few meals; after that, new and skimmed milk mixed; then skimmed milk alone, or porridge made with milk, water, ground oats, &c. sometimes with oil-cake, &c. until cheese-making commences; after which they have whey-porridge, or sweet whey in the field, being carefully housed in the night until the warm weather come in.

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and Feed-
ing of Black
Cattle.

A late intelligent Scottish clergymen, Mr John Bradfute of Dunfyre, once or twice successfully made trial of treacle, as a food by means of which to rear calves without the aid of any kind of milk. He used it diluted with common water, and sometimes with what is called *hay-tea*, that is to say, water in which hay had been boiled. The whole expence of the treacle necessary to bring a calf the length of using common food was at that time (16 years ago) about 4s. 6d. The animals came forward well, and enjoyed good health; but they grew much to the bone, and did not fatten for a considerable time.

Mr Brad-
fute's mode.

"During the first five or six weeks of their lives young calves very frequently die of a disease called the *chords*, which usually comes on with a trembling fit, and appears to be of an inflammatory nature. The following mode of preventing it is recommended by an anonymous writer*: "How soon the mother gets a little rest after calving, she is milked, and a little of the milk given to the calf as early as possible. If the weather is cold, and the mother long in giving milk, it is taken to the fire,

Disease
called the
chords.

C c 4

and

* *Farmers Magazine*, August 1803.

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ing of Black
Cattle.

and warmed in a pan until it is blood warm, and then given to the calf, about six or eight gills, according to the size of the calf, and repeated four times in 24 hours. As the calf gathers strength, the quantity may be increased; but too much of the milk at one time is as bad as too little, until it is a month or six weeks old. When the calf is able to stand, I tie it to a stake, as it is more in the power of the servant to give it milk in that situation than when going about loose. If a calf gets cold milk, it is sure to bring on a trembling, and the chords or some other malady follows, which I have often seen exemplified amongst the young stock of my neighbours. The above has been my scheme of rearing calves, and I never had one died of the chords, if fed in this way and kept dry."

Cattle are
pastured,

For feeding cattle, two modes of practice have been proposed, and in some situations adopted; the one mode, which is the most ancient, and the most extensively practised in agricultural countries, consists of turning out the cattle during the whole season that any food for them can be found on the ground, and of taking them into the house during the severity of winter, and of feeding them with such articles as can be most conveniently procured in the climate and situation, such as, straw or hay of different kinds, and roots.

or stall fed.

The other mode which has been adopted to some extent by husbandmen in Germany, and at times also in our own great towns, by persons called *cow-feeders*, who supply the inhabitants with milk, is called the system of stall-feeding. It consists of keeping the cattle continually in the house at every season of the year, and of feeding them there. If they are confined,

and

and fed with green food in a yard on which abundance of litter is spread, it is in England called *soiling*. By many German writers upon rural economy, this system is highly approved of, as affording the means of drawing the highest possible produce from every portion of the land, and as employing a great number of hands in the useful occupations of husbandry. In a communication to the Board of Agriculture from A. Thaer, M. D. physician of the electoral court of Hanover, the advantages of this system are said to be founded upon the following incontrovertible principles:

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ing of Black
Cattle.

Stall-feed-
ing in Ger-
many.

“ 1. A spot of ground which, when pastured upon, will yield sufficient food for only one head, will abundantly maintain four head of cattle in the stable, if the vegetables be mowed at a proper time, and given to the cattle in a proper order.

“ 2. The stall-feeding yields at least double the quantity of manure from the same number of cattle; for the best and most efficacious summer manure is produced in the stable, and carried to the fields at the most proper period of its fermentation, whereas, when spread on the meadow, and exhausted by the air and sun, its power is entirely wasted.

“ 3. The cattle used to stall-feeding will yield a much greater quantity of milk, and increase faster in weight when fattening than when they go to the field.

“ 4. They are less subject to accidents, do not suffer by the heat, by flies and insects, are not affected by the baneful fogs which are frequent in Germany, and bring on inflammations: on the contrary, if every thing be properly managed, they remain in a constant state of health and vigour.”

It is added that a sufficient, or rather plentiful supply

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ing of Black
Cattle.

ply of food for one head of cattle daily, if kept in a stable, consists upon an average of 130 pounds of green, or 30 pounds of dry clover, which answers the same purpose. Hence one head of cattle requires in 365 days, about 10,950 pounds of dry clover, or about 100 cwts. of 110 pounds each; the portion of food being according to this mode of feeding alike both in summer and winter. Each head of heavy fat cattle fed in the stable, if plenty of food be given, yields annually 16 full double cart loads of dung. The rotation of crops that is most frequently used in Germany, upon farms occupied in stall-feeding, appears to be the following: "One year, manured for beans, pease, cabbages, potatoes, turnips, linseed, &c.; 2. Rye; 3. Barley, mixed with clover; 4. Clover, to be mowed two or three times; 5. Clover, to be mowed once, then to be broken up, ploughed three or four times, and manured; 6. Wheat; 7. Oats."—In consequence of the large quantity of stable dung produced upon farms thus occupied, every acre of land receives every three years 10 double cart loads of that best of all kinds of manure.

Advantages
of the prac-
tice.

It is undoubtedly to be wished, that a similar mode of management could be profitably introduced into this country, from the tendency which it would have to augment the number of persons occupied in rural affairs, from the importance which it would give to arable farms of a moderate extent, and from the benefit which must arise from making the most of every part of the soil. It has already been introduced into several places in England; and we have little doubt that the practice will gradually extend itself, in consequence of the increasing demand

demand for butchers meat, and for all the productions of the dairy.

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and Feed-
ing of Black
Cattle.

Mr Young observes *, that "lucerne and tares should never be consumed in any other way, but every other crop will be used to proportionable advantage: cows also do very well when regularly fed in this manner; and it is so profitable that it can never be recommended too strongly."

Opinions in
favour of
the prac-
tice.

In his travels he observed particularly† "the practice in Flanders, and in some degree in Quercy, &c. of keeping cows, oxen, and all sorts of cattle, confined in stables the whole year through. This I take to be one of the most correct, and probably one of the most profitable methods that can be pursued; since, by means of it, there is a constant accumulation of dung throughout the year, and the food is made to go much farther."

In an Essay formerly quoted, the Rev. H. J. Close remarks, that "the only objection to carting the green vegetables home to sheds, both in winter and summer, is the additional labour and expence; but these are paid for in a tenfold degree by the increased value of the food, the thriving of the cattle, the making the dung under cover, and having reservoirs to catch the urine. With this management one good acre of turnips will produce an excellent dressing for an acre and a half of land, and will completely winter-fat an ox of 50 score. If fed on the land, two acres may fat an ox, but not so well, and the dressing will be very partial and precarious.

"Horses,

* *Annals of Agriculture*, vol. xxxii.

† Vol. ii.

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and Feed-
ing of Black
Cattle.

“Horses, bullocks, cows, &c. of all sorts, should, in my opinion, be under sheds winter and summer, except a few hours in the day time in winter, and a few hours in the evening or at night in summer. One acre of grass, clover, lucern, or vetches, cut and carted to the sheds, will support three times as many cattle in better order than the same acre when fed in the common way. The waste in this mode must be great from the trampling of the cattle; and, on pasture lands, they will naturally pick the most palatable grasses first, and leave the others to run up to bents. No mixture of cattle can prevent this; for though one sort may prefer one species of grass, and another another, it is altogether impossible to proportion each species of cattle to the species of grass most palatable to it, as to prevent a scarcity of one sort, and an abundance of the other. It must also be observed, that when there is a mixture of cattle, they frequently interrupt each other, and do not thrive. By stalling, all the green food is eaten, and no part of it wasted. The cattle fill themselves in half the time, and have more hours for rest. They cannot interrupt each other. The dung made under cover is not only much stronger, and in much larger quantities, but can be applied to any part of the farm, instead of being almost entirely lost, as when dropped on the pastures. The cattle are never liable to kick each other, or to be damaged by breaking pasture; and it will never be necessary for a ploughman to lose a day's work, searching the adjoining fields or parishes for his horses. These experiments and arguments will, I trust, appear conclusive, as to the best mode of applying green vegetable food both in summer and winter. For my horses I have erected cheap thatched sheds, in which they have room

to walk and roll, and in these they go winter and summer; to which I attribute it, that they are not so liable to cold as those kept in a hot stable, and are never cracked or greasy-healed. For my bullocks and cows my stalls are seven feet wide, each stall holding two head of cattle, each fastened by the neck close to the side of the stall to prevent their interfering with each other with their horns.

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and Feed-
ing of Black
Cattle.

Upon the the same subject, the following letter from a gentleman in Leeds to Messrs. Rennie, Brown, and Shireff, together with their remarks upon it, is worthy of attention. "There are a few cows kept in the house all summer, and the way in which they are managed is by giving them grafs fresh cut, and watering the ground, as the grafs comes off with the urine from the cows. The urine is preserved in a cistern placed on the outside of the cow-house, and is conveyed to the land at almost all seasons, but the most profitable time for doing it is March, April, and May; by which means and the addition of horses dung applied during the winter months, the field may be cut four or five times during the season. I am told four acres of land will, in this method, maintain ten cows; and in the winter they are fed with grains from the brewers, which are very high in price, being 3s. 6d. per quarter. It will take about four pounds worth of grains to maintain a cow for the winter months, and two pounds for grafs during the summer; so the expence of a cow for the whole year is about six pounds.

"I kept 13 cows one winter, which were fed upon turnips and oat-straw, and never got a mouthful of hay. They yielded me 30 gallons of milk per day which, six years ago, sold upon the spot to the retailers from Leeds,

at

Breeding and Feeding of Black Cattle. at $5\frac{1}{8}$ d. per gallon. They carried it a mile, and sold it out at $6\frac{1}{2}$ d. and 7d. per gallon; but it is now advanced to 8d. and 9d.

“I must notice to you, that the taste of the turnip is easily taken off the milk and butter, by dissolving a little nitre in spring water, which being kept in a bottle, and a small tea-cup full put among eight gallons of milk, when warm from the cow, entirely removes any taste or flavour of the turnip.

“In the management of cows, a warm stable is highly necessary; and the currying them, like horses, not only affords them pleasure, but makes them give their milk more freely. They ought always to be kept clean, laid dry, and have plenty of good sweet water to drink. I have had cows giving me two gallons of milk at a meal, when within ten days of calving. The average of our cows is about six gallons per day after quitting the calf.

“In addition to the above very sensible letter, we may add, that one of us, for some years, has kept his cows in the house upon red-clover and rye-grass during the summer months. They are put out to a small park in the evening after milking for the convenience of getting water, and tied up in the house early in the morning. One acre of clover has been found to go as far in this way as two when pastured. More milk is produced, and the quantity of rich dung made in this method is supposed to compensate the additional trouble of cutting and bringing in the grass.”

Two modes
of stall-
feeding.

Of stall-feeding, however, whether with a view to the maintenance or to the fattening of cattle, it must be observed, that there are two modes of proceeding. Of late years it has been found advantageous to culti-

vate

vate to a great extent turnips, potatoes, and other roots, and these now constitute a large portion of the winter food of cattle. These roots are either given to the cattle in their natural raw state, or they are given after being boiled. Of these two modes of feeding, that of giving them to the cattle raw has hitherto been the most common, but it is extremely improper, as being a thriftless plan of proceeding. The same quantity of these roots, if given in a raw state, that will barely support a horse in idleness, will enable him, when boiled, to encounter the severest labour without injury to his health or spirit. There are many animals also, such as hogs, which cannot be fattened by roots unless they undergo this process. These animals can be reared to the full size upon raw potatoes, yams, carrots, roota бага, &c. and may be kept in good health for any length of time without the aid of any other food. Under that management, however, they very seldom if ever fatten; but when the roots are boiled, they immediately begin to feed, and soon become fat upon a smaller allowance than what was necessary to keep them barely alive when given in a raw state.

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and Feed-
ing of Black
Cattle.

The same holds true in a great degree with regard to all cattle. With a view, therefore, to make the most of the various succulent roots which are now cultivated, and which will perhaps one day be accounted the most valuable productions of our soil, it is absolutely necessary that they should be given to cattle boiled. Many husbandmen have long been sensible of this, but it has appeared a very formidable operation, to boil the greatest part of the food of perhaps 20 horses, and 100 head of black cattle. There is nothing more true, however, than that this labour, when undertaken upon skilful

Roots gi-
ven to cat-
tle should
be boiled.

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and Feed-
ing of Black
Cattle.

skilful principles, may be rendered not only easy, but so trifling, that it may be performed by a single old man, or by a woman. To accomplish the object, however, it is necessary, that the roots be boiled not over the fire in a caldron of metal, but at a distance from it, in a large wooden vat or tub, by the steam of boiling water.

Cheap
mode of
boiling
roots by
steam.

There are two ways of boiling roots by steam. They may either be boiled in such a way as to retain their original figure, or they may be converted into soup; both modes are performed with equal ease. All that is necessary, is to erect a boiler in any outhouse: The boiler, which may be of cast iron, ought to have a close cover or lid, having a small hole for filling it with water, which can be easily closed up, and another hole in the centre of about one-fourth of the diameter of the cover. To this last hole ought to be foldered a tube of tin-plate, commonly called *white iron*, by which the steam may ascend. This tube ought to rise perpendicularly to the height of six feet, narrowing gradually to about two inches diameter. It may then bend off at right angles, to the most convenient situation for the tub or vat in which the roots are to be boiled. When it comes perpendicularly over the centre of the vat, it must be made to descend to within two or three inches of the bottom of it, being properly supported and fixed all the way.

To boil roots with this apparatus, it is only necessary to tumble them into the tub or vat into which the end of the white-iron tube descends. The tub ought then to be covered negligently. The water in the boiler being heated to ebullition, its steam or vapour rises and passes along the white-iron tube, and at last descends

descends to the bottom of the wooden vessel containing the roots, and in a very trifling period of time renders them completely soft. If it is wished to convert these roots into soup, it is only necessary to throw among them a quantity of water, and to beat them down with any large ladle or other instrument. The steam continuing to descend will speedily boil the water, and agitate and mingle the whole ingredients of which the soup may be composed. In this way, by various mixtures of roots, with little or no trouble, rich broths, which human beings would not dislike, may be formed for feeding a multitude of cattle, and the soup may easily be drawn off from the bottom of the vat by means of a hole to be occasionally opened or shut with a round piece of wood.

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and Feed-
ing of Black
Cattle.

In performing the above operation, however, of forming broth or soup, before allowing the water in the vessel over the fire to give over boiling, the hole ought to be opened by which it is usually filled with water, as the liquor in the vat might otherwise, in consequence of the pressure of the atmosphere, ascend through the white-iron tube and come over into the boiler. To strengthen the white-iron tube, it may be proper also to cover it all over with paper pasted to it with glue, or with a mixture of pease-meal and water.

A still more simple mode of boiling potatoes or other roots, by steam, is described in the Annals of Agriculture *, as used by Mr Crook of Tytherton in North Wiltshire, who uses potatoes thus dressed on a large scale for fattening oxen. "He takes a vessel fitted to the size

Another
mode.

VOL. II.

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of

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and Feed-
ing of Black
Cattle.

of his boiler. One that is generally made use of for heating water for washing is sufficiently large, holding about eight or ten gallons of water. In the bottom of this steamer there are a number of holes about the size of a common auger, which allow the steam to pass through the potatoes with which the boiler is filled; the bottom, where it rests on the mouth of the boiler, being made tight with a wet cloth, to secure the steam from escaping. The steamer, for ease in emptying and filling, does not hold more than from one to two bushels. The potatoes are quickly dressed, and the water draining from these supplies the exhausting of the steam; they are then overturned into a cooler, and more put in their place: the potatoes are afterwards mixed with chopped hay and straw. The cattle are kept in houses or sheds, and furnished with this food without any addition of corn.

Rules for
fattening
cattle.

To fatten cattle with success, then, we apprehend that the following rules ought to be adhered to. As a man is kept thin and meagre by whatever agitates his mind, or renders him anxious, fretful, and uncomfortable, so we ought to consider that cattle, though they want foresight of the future, have nevertheless minds capable of being irritated and disturbed, which must so far waste their bodies. In attempting to fatten them, therefore, care ought to be taken to preserve the tranquillity of their minds, and, as much as possible, to keep them in a state of cleanness and of moderate warmth. The food they receive ought to be varied at times to increase their appetite; but, above all things, it ought to be made as far as possible of easy digestion, that they may receive it in larger portions, and that a greater quantity of it may incorporate with their constitution,

stitution, and not be thrown off by dung, as happens when they receive coarse nourishment. It is in vain to object to this artificial mode of proceeding, that the natural food of animals is grass alone, and that their natural dwelling is the open air. The same might be said with regard to the human species. In this natural, that is, in this unimproved state, a savage may be under the necessity of eating raw flesh or herbs, or of climbing into a tree for shelter; but although it may be possible for him to subsist in this way, yet we know that this is by no means the best mode of his existence, and that his life and health are better preserved by the shelter of a settled dwelling, and by more delicate food prepared by industry. In the same manner, it is no doubt true, that cattle can exist upon very coarse food, and may be even fattened by means of it; but as a greater quantity of it becomes necessary, the husbandman's profit in rearing them is so far diminished, and the value of his lands to the community is lessened.

Rearing
and Fatten-
ing Hogs.

SECT. IV.

OF THE REARING AND FATTENING OF HOGS.

UNDER a proper mode of management, from their rapid multiplication and quick growth, these are a very profitable kind of stock; though they have not hitherto been reared in Scotland, or fed by farmers systematically, upon a great scale. To do this with advantage, every thing depends upon adopting a proper plan for providing them with subsistence. "Whoever designs, says

Rearing
and Fatten-
ing Hogs.

Mr Young's
rules for
rearing
hogs pro-
fitably.

Mr Young *, to enter largely into keeping hogs, must make a very ample provision of food for all the seasons of the year, and for every sort of stock: if he does this with a proper foresight, he will find that no animal upon his farm will pay him better; but, on the contrary, none will answer worse, if not supported in great plenty. The following are the articles of food, which he must particularly attend to.

“*Clover.*—Whoever would make the most profit of which his hogs are capable, must not think of doing it without the assistance of this plant. The great use of it in supporting swine was very little known till of late years. I have practised it many years with the greatest success. A small clover field, very well fenced, with a pond in it, should be ready to receive the hogs the beginning of May. When first drove, a man and boy should keep with them late the first two or three evenings, to see that they do not attempt breaking out to come home, and to drive them to some warm hollow under shelter in a dry ditch, or under a small moveable shed littered: they will take very readily to such; and having been used to it a few nights, you need be under no further trouble about them till after harvest, or till the acorn season or the clover is done. All hogs that are past weaning, that is, a quarter, half, and full-grown; boars, and sows that have no pigs with them; sows whose pigs are in the sty, and themselves let out to bait: for all such, it is as fine food as can be provided; and there is no other way of keeping them nearly so cheap.

* *Annals of Agriculture*, vol. xxxii.

cheap. An acre will feed from 12 to 20 middling-sized hogs through the summer. Rearing
and Fatten-
ing Hogs.

“Lucern.”—The best culture of this grass does not admit in common of its being fed; if used for swine, therefore, it must be sown for soiling. This I have known practised with very good success. For one month's food, however, in the spring before clover is ready to feed, lucern would be very profitable.

“Tares.”—The same observation is applicable to winter and spring plants; they must both be given in small racks, or else scattered over a small grass field adjoining to the hog-yards.

“Potatoes.”—Of all articles of food which it is necessary to provide very amply, none is so indispensably necessary as this root. The farmer ought every year to have several acres of the Howard or clustered sort, as that yields by far the greatest crop. They are of use in every step of the hog's progress. Boiled, but better steamed, they will wean young pigs, and fatten the largest hogs; and raw, they are an excellent support to all other stock; such as sows, shoots, and full-grown hogs. When a farmer has found how many bushels an acre of his land will yield, he may then proportion them upon this hint, that 300 bushels will winter-feed, during six months, 15 shoots, having some other assistance, to begin when three or four months old; and the advantage by feeding them will, according to circumstances, yield from 4d. to 6d. per bushel; but, on an average, 5d. supposing the times respecting hogs to be good: and in fattening them the potatoes will pay also from 4d. to 6d.

“Carrots,” though inferior to the preceding root for hogs, are of great use; they do excellently well for all

Breeding
and Fatten-
ing Hogs.

forts of lean stock ; and also for weaning pigs, with the assistance of a little dairy wash. Several other persons have fattened hogs on them boiled ; but as they have often failed, and potatoes are certainly superior, I say nothing of that application. Upon very poor sandy soils, they should be substituted instead of potatoes, much more than on better soils ; for the cluster potato will yield very large crops on such. But carrots come to a considerable produce on the very poorest, and without dung ; hence they are amazingly valuable, in such countries, to those who would go any length in keeping hogs.

“ *Parfnips* are, I believe, to be preferred greatly to carrots. They fatten all their pork in the island of Jersey with them. They are a much more saccharine root ; and it is known, that nothing fattens a hog faster, or makes finer pork, than the sugar cane.

“ *Cabbages*.—From September to the end of December there is no plant will keep the common stock so cheaply as this, while they are green and fresh ; and before much of them grows putrid or turns yellow, they yield an immensity of food, which will support the sows and shoots to their growth, but will not do to wean upon, without considerable assistance.

“ *Turnips*.—The same is to be observed of turnips, but in an inferior degree ; for cabbages are a much better food.”

Of breeding
hogs.

This author remarks, that there is an endless variety of breeds of swine in England ; but he prefers the large Chinese breed, which rises to a considerable weight : he remarks, that the sows should always be kept confined in their yard, except when they are in the clover field ; they should not go to the boar till they are

nine

nine months old, and, if they are a year, it will be better. When great with pig, they must be in a yard by themselves in winter, not to be disturbed by the boars and shoats; and for about a fortnight before they pig, they should be confined to the sty, but each to have a small area to it. While pigging, it is essential that nobody goes near them, not even to look at them; for some will eat their pigs, in that case, that would never touch them, if they were not disturbed. They should be fed moderately before pigging, but afterwards they must have as much as they will eat of dairy wash, and baits of turnips, carrot, cabbages, or potatoes, for want of wash, with boiled potatoes or carrots, and a little meal, once a day, for a fortnight. They must be kept well littered and clean; but at pigging, not with too much, as they are more apt to overlay their pigs in it for the first week. When they have pigged a week or ten days, they may be let out of the sties into their yard for three or four hours in the middle of the day to stretch their legs, which is better than total confinement.

Rearing
and Fatten-
ing Hogs.

“Sows, when expected to take the boar, should not be kept too fat. I have been told by an observing farmer, that when his sows have gone to boar in a great acorn time, being in high order, they have never had many pigs; and that it was a common observation.

“The proper age at which to wean pigs is two months, having castrated them at six weeks. They must be kept in sties that have a small yard for them to run in, and both kept perfectly clean and well littered with wheat straw or stubble. Their food must be good, and given as plentifully as they will eat. Boiled potatoes or carrots for a fortnight, and then raw ones, will prove

Rearing
and fatten-
ing Hogs.

a good food ; with a bait every day, for a month, of oats, and afterwards pea or bean or buck-wheat meal, unless there is a dairy ; and then a mels of milk or whey will answer instead of it. This must be the management till the clover field is ready for them, which may be the beginning of May ; and if the pigs are three months old, they will do well on that food. During the weaning the article of plenty of clean straw and great cleanness, so as the pigs may always have fine smooth sleek coats, is of such consequence, that the greatest plenty of food will not make amends for the want of it.

“ The young hogs that are weaned, and arrived at the age of three or four months, must, through the year (except when in clover) be confined to a yard by themselves. Their food may be turnips or cabbages, potatoes or carrots ; also malt grains, if they sell, as they do in many places, at 3d. a bushel. Turnips alone will not do ; they should with them have an allowance of corn : cabbages are much better ; but carrots and potatoes will keep them without any help to their full growth. If it is summer, nothing is better than the clover field.

“ For older hogs, of course, the same regimen will, for ordinary food, be sufficient.

Fattening.

“ To fatten any kind of swine, use may be made of potatoes ; but for this purpose they must be boiled or steamed, and a small quantity of any kind of meal may be added with advantage. “ When hogs are fattened on corn, says Mr Young, I am clear in the advantage of grinding it to meal ; in which state, given dry, I have fattened many hogs very expeditiously ; but they must have water always by them, as they seem to fatten in proportion

proportion to their drought. But, if corn is bestowed, by much the best way of using it is to put the meal into cisterns or tubs, and add water enough to make it of the consistence of cream; to keep it stirring every day till it has fermented and become sour, which, in weather not very cold, will be in three weeks; and then to give it to the hogs, keeping messes prepared beforehand to succeed each other. I have tried this method many years, and with uniform success; and have found, by weighing the hogs alive every week, and making comparisons with the food, that none come up to it, being the most profitable of all others. Use half barley and half pease-meal, to choose; but if not, all of either; beans do not make so good pork. I do not perceive that the hogs are ever drunk with it, which they of course would be, if the vinous fermentation took place. The drunkenness of the distillers hogs is said to be the reason of their fattening.”

Rearing
and Fattening
Hogs.

This last circumstance has induced some persons to mix small quantities of poppy seed with their food, or even opium itself; and the practice, when managed with delicacy, is said to have proved advantageous.

“With regard to the profit to be made by entering Profit, largely into this branch of husbandry, it will depend, as in most other cases, on a variety of circumstances; I mean the *degree* of the profit; for in every situation with which I am acquainted, the advantage is not inconsiderable. It will depend on the price of lean hogs, and on that of fat pork; and also on the crops, and the cheapness with which cabbages, carrots, potatoes, and clover, can be raised. To give any particular calculations would not, therefore, be easy: in general, however, I shall observe, that there is no sort of stock kept

Rearing
and Fatten-
ing Hogs.

kept upon a farm that will pay better than hogs; but this depends on very ample provision being made for them, as I know no stock that will less bear a deficiency of food."

A sow will produce three litters in fourteen or fifteen months, so that the produce within a year is very great. "In general the advantages to be reaped from this stock are more applicable to all sorts and sizes of farms, to very small, as well as to extremely large ones, and to every place and situation. But it is very rare that I have seen the benefit made of them, which they will admit of; resulting from the unwillingness, so general among farmers, to raise crops on purpose for them: they can keep a few without any expence whatever, and therefore they will not raise food for many. It is very easy for a young farmer to try the experiment on two or three sows, and the pigs bred by them; or by buying in ten or a dozen shoots at Michaelmas: the clover will probably be on his farm, and a very few cabbages, potatoes, or carrots, would do the rest."

Description
of a proper
hog-sty.

Hog-sties are of simple construction; they require only a warm dry place for the swine to lie in, with a small area before, and troughs to hold their food. They are generally made with shed-roofs, and seldom above six or seven feet wide.

Although swine are generally considered as the filthiest of all animals, yet there is no animal delights more in a clean comfortable place to lie down in, and none that cleanliness has a better effect upon with respect to their thriving and feeding. In order to keep them dry, a sufficient slope must be given, not only to the inside where they lie, but to the outside area, with proper

proper drains to carry off all moisture. The inside should also be a little elevated, and have a step up from the area at least five or six inches. Hog-sties should have several divisions to keep the different sorts of swine separate, nor should a great many ever be allowed to go together; for it is thought they feed better in small numbers, and of equal size, than when many are put together of different sizes. Proper divisions must, therefore, be made, some for swine when with the boar, others for brood swine, and for them to farrow in, for weaning the pigs, for feeding, &c.

Swine are apt to spill and waste a great deal of their meat by getting their feet among it, unless proper precautions are taken to prevent them. This may be done by making a rail or covering of thin deal slope from the back part of the trough towards the fore part, leaving just room enough to admit their heads. There should also be divisions across the troughs, according to the number of swine, to prevent the strongest driving away the weakest. These divisions need not extend to the bottom of the troughs, but should rise a little higher than the top, and may be made of pieces of board about eight or ten inches board.

Sties ought to be so constructed that the swine may be easily fed without going in among them. In some places it is so contrived that they may be fed through openings in the back kitchen wall, without ever going out of doors. This is very convenient where only a few swine are kept for family use, and makes it easy to give them the refuse of vegetables and other things from the kitchen, which, perhaps, would otherwise be thrown away. Where pigs are to be reared on an extensive scale, there ought to be what is called in England

Rearing
and Fatten-
ing Hogs.

Rearing and Fattening Hogs. land a *pigs kitchen*, that is, a proper apparatus ought to be erected adjoining to the hog-sty, for boiling their food by steam.

Example of hogs fed with clover and potatoes, &c. In a letter to the Earl of Hardwicke, which was communicated to Mr Young, the Right Honourable Theophilus Jones, an Irish gentleman near Dublin, gives the following account of his mode of feeding hogs among clover and potatoes, which will probably supply some useful hints to a judicious farmer *.—“ I have for ten years, (says this gentleman), kept from twenty-five to thirty swine for the use of my house, (eight of which, when sufficiently fat for bacon, weigh more than two hundred weight), by penning them upon clover, from the latter end of April to the latter end of October, in a space of about twenty yards square, hurdled or railed off. The fence is changed every day, and the hogs are driven to the spot at five o'clock in the morning, and brought back to their sty at six in the evening, where they are fed with the broth and butter-milk from the kitchen and dairy. In this manner, without any other food, they are kept in good condition, as store hogs, till the month of November, when it is necessary to feed them for use. A plantation acre and a quarter (which is equal to two English acres) of tolerably well grown clover, is sufficient to feed them during the season, as they go over the same ground, according as the season answers, and as the clover grows again, three or four times, leaving the space they feed upon each day as bare as a fallow; so that by the time they have gone over the land three times in this manner, it will be highly

* *Annals of Agriculture*, vol. xxxiv.

ly manured for potatoes against the next spring, and will produce much more food than will be necessary to keep the same number of hogs for the remainder of the year, and to fatten such as are necessary for the use of the house. Rearing
and Fatten-
ing Hogs.

The bacon hogs are fed by themselves, and there is a place raised about a foot from the ground sufficient for them to sleep upon, railed close at the bottom, to prevent their straw from being dirty or wet. The troughs for their food are upon the ground, and they are fed four or five times in the day, with potatoes boiled in steam and the wash milk from the dairy: In two or three months at most they are fit for use. The sows and hogs intended for pork are kept in the common sty, and fed upon the small potatoes well-washed, but not boiled for them. The small Chinese hogs answer best for pork, and are bred at home. As they are wanted for the table, they are put into separate cells, and fed with boiled potatoes and milk or broth, in the same manner as the bacon hogs, and in two months are fit for the table.

“Never having been disappointed in the course of my experience by feeding swine in this manner, I conceive it might be advantageous to farmers to extend the practice much farther than I have done, and that it may be of use to them (if they can be induced to make the experiment) to know how I have managed the land that has been applied to that purpose. The ground that the hogs have fed upon is ploughed as soon as may be convenient after they are taken off, and well-worked three times before the middle of March, by which time it is sufficiently tilled for potatoes. I plant the potatoes in drills twenty-eight inches distant.

Rearing
and Fatten-
ing Hogs.

distant. A plantation acre will produce from thirty to thirty-six tons. By having the stalks, when the potatoes are ripe, pulled and taken clean off the land, a plough, with a strong draught of horses or oxen, will take out an acre of potatoes in a day, much cleaner and better than they can be done by the spade, as the plough does not cut them. The plough must be let deep into the ground, and go up and return again upon each drill. There must also be sufficient pickers to gather the potatoes, or the work will be retarded. I then harrow the ground across, and when convenient plough it thoroughly, and gather the potatoes that may have been left after the first ploughing, which will perfectly clean the land, and amply pay the expence of the labour, and leave the ground in excellent order for sowing barley, with red clover, in the spring.

“ In folding the hogs, observe not to leave any furrows, that the pens may be so close to the ground, that the small swine may not be able to run under them.

“ By this course of tillage a succession of profitable crops may be produced for three years, and the land (without any other assistance) sufficiently manured both for the potatoes and barley.

“ At first I tried leaving the swine out day and night, which did not answer; and I have, upon very severe rain, found it better not to turn them out upon the clover, but to give them cabbage-leaves and lettuces from the garden: but this seldom is necessary.”

SECT. V.

SHEEP.

THE rearing of sheep properly belongs to the article ^{Experiments on} pasturage. So far, however, as they are fed upon the ^{feeding} products of human industry, they belong to the present ^{sheep with} subject. In the Memoirs of the Royal Society of Agriculture in Paris for the year 1788, the result is given of certain experiments upon the advantage and economy of feeding sheep in the house with roots. The experiments were made by M. Crette de Palluel. He states that the custom of feeding sheep in a house is common in several of the French provinces, but in others is unknown : That the mode of fattening them in that situation consisted of giving them clean corn and choice hay : That in substituting roots for corn, hay was continued to be given to them, either of clover, lucern, after-math, or any other sort. The corn commonly used for fattening sheep is barley and oats ; sometimes gray pease, or the marshed beans, and rye. “ Although the sheep fed upon roots (says M. Crette) did not acquire quite so great a degree of fatness as those fed upon corn ; it is however true, that they all fattened, and that if their food had been varied, they would have made greater progress : I can even assert the fact of four, which were put upon change of food towards the end of the experiment, and ate much more.

“ The

Sheep.

“ The sheep put to potatoes ate little at first, for some days, which prevented them from thriving so much as the others ; but they recovered the second month what they lost the first. As for those put to turnips and beets, they fed heartily from the first moment, and continued it. They all drank much less than those fed upon corn.

“ Corn might with advantage be added to the roots : When the sheep are intended to be sold, two feeds of corn given them for a fortnight, in the intervals of their meals of roots, would harden both their flesh and their tallow.

“ It was not sufficient to prove the possibility of fattening sheep with different kinds of roots ; it was farther necessary to ascertain the qualities which their flesh might acquire, by the use of them. Four sheep, fed upon the four regimens, were killed the same day ; there was indeed some trifling difference in the texture of their flesh, but upon the whole the flavour of all was the same. Let us then conclude, that the culture of roots opens to us infinite resources, not only for fattening of sheep, but also of beasts ; and we do not doubt of their being used to the greatest advantage in bringing up cattle in the countries where they are bred.

“ The knowledge of these experiments must induce farmers to adopt this culture, since it is so advantageous. Roots cannot be exported ; corn, on the contrary, is exported ; and the grower may sell the roots instead of consuming them. One acre of roots is equal to five acres of corn. By this means he multiplies his land, and may consequently multiply his cattle and his

his dung-hill: added to this, roots are not subject, Sheep.
 like corn, to the inclemencies of the seasons; the produce is always more certain; these plants being of different natures, it is not likely that they should all fail; the earth is a more faithful depository of our treasures than the atmosphere; the dreadful hurricane of the 15th of this month (July) destroyed every thing but roots; they are the only product which escaped its ravages; if the hail tear their leaves, others will soon shoot; and carrots, beets, turnips, and potatoes, will be safe."

The result of the experiments alluded to is given in the following terms:

Sheep.

EXPERIMENT upon Fattening Sheep; and their Increase from Month to Month.

Sixteen sheep, of the same age, of four different breeds, were picked out of my flock, viz. four the breed of the country, four of Beauce, four of Champagne, and four of Picardy; I weighed them alive, and marked each with a number; I divided them into four lots, and fed them on four different sorts of food, as under.

Food.	N ^o	Breeds.	Weights at different Periods.—1788.					Increase each Month.				Total incr. which each food has produced upon four Sheep.
			Jan. 20.	Feb. 20.	Mar. 20.	April 20.	May 20.	1st M.	2d M.	3d M.	4th M.	
Potatoes,	{ 1 2 3 4	Ile de France, Beauce, Champagne, Picardy,	69½ lb.	79½ lb.	—	—	—	10 lb.	lb.	lb.	lb.	{ 70 lb.
			70½	82½	90½ lb.	93 lb.	95 lb.	11½	7½	2½	2	
			69¼	83	82½	84	—	13½	10½	1½	—	
			88	95	101	—	—	15	6	—	—	
Turnips,	{ 5 6 7 8	Ile de France, Beauce, Champagne, Picardy,	69	86	87	—	—	50½	13½	4½	2	{ 67½
			71	86	—	—	—	17	1	—	—	
			68½	78½	82½	84	84½	15	—	—	—	
			79	95½	97½	97½	—	10	4	1½	—	
								16½	2	—	—	
								58½	7	1½	½	

Sheep.

Beets,	{ 9 Ile de France, 10 Beauce, 11 Champagne, 12 Picardy,	72	83½	90½	94	—	11½	7½	3½	—	71
		70½	80½	86	—	—	10	5½	—	—	
		77½	90½	—	—	—	13½	—	—	—	
		80	93½	98½	100½	101	13½	5	1½	½	
Oats, barley, and gray peas.	{ 13 Ile de France, 15 Beauce, 16 Champagne, 14 Picardy,	74	91	95½	102	106	48	17½	5	½	92½
		73½	84½	91½	96	—	17	4½	6½	4	
		71	86½	93	—	—	10½	7½	4½	—	
		71	87	—	—	—	15½	6½	—	—	
							16	—	—	—	
							59	18½	11	4	

OBSERVATION. The increase of these sheep, during the first month, being so much more considerable than in the following months, must be attributed to this cause, that lean cattle put up to fatten eat greedily until they are cloyed, which only fills them, without much increasing their flesh; but, on the contrary, the increase produced in the ensuing months, although apparently less, turns all to profit in flesh and tallow."

SECT.

Rabbits.

SECT. VI.

RABBITS.

Rabbits
more va-
luable than
black cattle
or sheep.

IN particular situations these animals may be kept to advantage, as they multiply exceedingly, and require no trouble in bringing up. A considerable number of them are kept in Norfolk, where much land, consisting of barren hills or heaths, is proper for their reception. They delight in the sides of sandy hills, which are generally unproductive when tilled; but level ground is improper for them. Mr Marshal is of opinion, that there are few sandy or other loose-soiled hills which would not pay better in rabbit warrens than any thing else. "The hide of a bullock (says he) is not worth more than $\frac{1}{20}$ th of his carcase; the skin of a sheep may, in full wool, be worth from a sixth to a tenth of its carcase; but the fur of a rabbit is worth twice the whole value of the carcase; therefore, supposing a rabbit to consume a quantity of food in proportion to its carcase, it is, on the principle offered, a species of stock nearly three times as valuable as either cattle or sheep. Rabbit warrens ought to be enclosed with a stone or sod wall; and, at their first stocking, it will be necessary to form burrows to them until they have time to make them to themselves. Boring the ground horizontally with a large auger is perhaps the best method that can be practised. Eagles, kites, and other birds of prey, as well as cats, weasels, and pole-cats, are great enemies of rabbits. The Norfolk warreners

warblers catch the birds of prey by traps placed on the tops of ~~the tops of trees or~~ artificial hillocks of a conical form, on which they naturally alight.—Traps also seem to be the only method of getting rid of the other enemies; though thus the rabbits themselves are in danger of being caught.

Rabbits.
Method of
destroying
birds of
prey.

Rabbits may be fed during the summer with clover and other green food, and during the winter with cabbages. Where they are kept in an enclosure as part of the stock of the farm, a practice which has not yet been used in this country, they ought to be fed with great regularity, and with as much as they are willing to take. When this is done, they thrive upon a very moderate quantity of food; but if they are once allowed to suffer hunger in any great degree, they become extremely ravenous, and for a long time can scarcely be satisfied with food. In a communication to the Board of Agriculture from M. Bertrand of Mechlin, in the Netherlands, we are informed that the rabbits of the Angora breed yield in Normandy an uncommonly valuable wool, which serves as a primary material in several considerable manufactures. The Normans assert, that each rabbit yields wool of the value of a crown or six livres.

Angora
breed of
rabbits.

SECT. VII.

POULTRY.

In many places on the continent poultry are reared as a part of the stock of a farm, and a portion of the

Poultry. land is cultivated for the purpose of raising food for them. We are also informed, that this has been done in a few instances in England. In particular it is mentioned in the Annals of Agriculture *, that one Shalecroft, who had a farm of 400 acres, and who lately died worth ten thousand pounds, supplied the market of Croydon near London with fowls. In general, however, in that country, and universally in Scotland, fowls are kept merely as a kind of save-all, meant to be fed upon such trifling articles of food as might otherwise go to waste : Nor are we in possession of any facts, in consequence of which we could advise poultry to be kept as farm stock. It is certain, at least, that where numbers of them are kept upon a corn farm, they ought not to be allowed to go at large ; for not only will many of their eggs be lost, and many of themselves, perhaps, destroyed by vermin, but at certain seasons they do a great deal of mischief both in the barn-yard and in the field. No doubt, they pick up some grain at the barn doors that might otherwise be lost ; but if the straw is properly thrashed and shaken, there would be very little of this. In the common careless way of thrashing, a great deal of corn is undoubtedly thrown out among the straw ; but when we consider the dung of the fowls and their feathers that get among it, and the injury these must do to the cattle, this is no object. It is much better to allow the poultry a certain quantity of food, and to let the cattle have the benefit of what corn may remain among the straw,

If poultry, therefore, are to be kept at all, they ought
always

always to be confined, but not in a close, dark, diminutive house, as is often the case; they should have a spacious airy place properly constructed for them. Some people are of opinion, that each sort of poultry should be kept by itself. This however, is not absolutely necessary; for all sorts may be kept promiscuously together, provided they have a place sufficiently large to accommodate them conveniently and proper divisions and nests for each kind to retire to separately, which they will naturally do of themselves

Poultry.

This method is practised, with great success, at Mr Wakefield's, near Liverpool *, "who keeps a large stock of turkeys, geese, hens, and ducks, all in the same place; and, although young turkeys are, in general, considered so difficult to bring up, he rears great numbers of them in this manner every season, with little or no trouble whatever. He has about three quarters or near a whole acre enclosed with a fence only six or seven feet high, formed of slabs set on end, or any thinnings of fir or other trees split and put close together. They are fastened by a nail near the top, and another near the bottom, and are pointed sharp, which, I suppose, prevents the poultry flying over, for they never attempt it, although so low. Within this fence are places done up slightly (but well secured from wet) for each sort of poultry; also a pond or stream of water running through it. These poultry are fed almost entirely with potatoes boiled in steam, and thrive astonishingly well. The quantity of dung that is made in this poultry-place is also an object worth attention;

Mr Example of a proper mode of keeping poultry.

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and

Poultry. and when it is cleared out, a thin paring of the surface is at the same time taken off. ~~this makes~~ a valuable compost."

It is generally understood that a full-grown hen continues in her prime for three years; and that during that period, if properly fed, she will lay at a medium 200 eggs every year. The number, however, of eggs may be greatly increased by making the place to which this kind of poultry retire at night very warm and comfortable, by its being placed contiguous to a wall, on the other side of which a fire is kept, or by its being heated in any other manner. In the cottages of the poor in Scotland, where the poultry and the inhabitants sleep under the same roof, the hens continue with a moderate portion of food to produce eggs during the greatest part of the winter.

doubtful.

Upon the whole, however, we have great doubts of the propriety of attempting in this country to rear poultry upon a farm on a large scale for profit. What are with us called *barn-door fowls*, are originally the natives of the hot climates of India, where at present they receive the appellation of *jungle fowls*, from frequenting in their wild state woody thickets, which are there called *jungles*. With us they must be supported against the rigour of a foreign climate by large quantities of food, which has a tendency greatly to diminish the profit of rearing them. It is certain, at least, that they cannot be profitably fed upon grain. Were it once established, however, that they could be reared and fattened by boiled roots alone, such as potatoes, carrots, and parsnips, or by mixtures of these with cabbages also boiled, they might then be found no less profitable than many other kinds of stock, providing always they were kept in a confine

confined state. The example of Mr Wakefield's practice, ^{Poultry.} already stated, seems to give to such a plan a prospect of success. It might be worth while, providing the poultry enclosure was situated upon a sandy soil, to endeavour to augment the profit by feeding along with them a considerable number of rabbits, which are now become in this country a fashionable article of food, and consequently bring a considerable price in the market, while at the same time their wool must at all times be of great importance, and obtain a ready sale.

In Norfolk a great number of turkeys are bred, of a ^{Great number of tur-} size and quality superior to those in other parts. ^{keys reared in Norfolk.} Mr Marshall accounts for their number in the following manner: "It is understood, in general, that to rear turkeys with success, it is necessary that a male bird should be kept upon the spot to impregnate the eggs singly; but the good housewives of this country know, that a daily intercourse is unnecessary; and that if the hen be sent to a neighbouring cock previous to the season of exclusion, one act of impregnation is sufficient for one brood. Thus relieved from the expence and disagreeableness of keeping a male bird, most little farmers, and many cottagers, rear turkeys. This accounts for their number; and the species and the food they are fattened with (which, I believe, is wholly buck) account for their superior size and quality."

The following account of the Lincolnshire management of geese is given by Mr John Foot of Brandon, ^{Lincolnshire management of geese.} in the Annals of Agriculture, vol. xiv. "It is generally allowed, that three geese to one gander is sufficient; more geese would be too many, so as to render the eggs abortive. The quantity of eggs to very goose for sitting above 12 or 13. They must be fed with corn in

Poultry. in their water whilst sitting, near them, so as to feed at pleasure. The ganders should be allowed to keep near them, so that they can see them, as they will naturally watch as a guard over their own geese.

" Their nests should be made for them of straw, and confined so as the eggs cannot roll out when the geese turn them, which they do every day.

" When near hatching, the shell should be broke a little against the beak or bill of the gosling, to give air, or to enable it to receive strength to throw off the shell at a proper time. The method of plucking them about the beginning of April is this: Pluck gently and carefully the fine feathers off their breast and back; but be careful not to pull or interrupt their down nor pen feathers.

" You also pull their quills, five out of a wing; but I think four would be better. The quills will bear pulling in 13 or 14 weeks again, twice in a year; the feathers three times a year, of the old geese and ganders, seven weeks from the first pulling; and then again seven weeks after, which is the last pulling of the year.

" The young geese may be pulled once at 13 or 14 weeks old, but not quilled, being hatched in March.

" If the geese are late in hatching, I expect the brood geese should not be plucked so soon as April, but the month after.

" If they are fed with barley and oats, as they ought to be, they will thrive and do the better, and their feathers will grow the faster, and be better in quality; they must have plenty of grass and water.

" Although persons not acquainted with the management of geese, as above described, may think it unhu-
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man; yet I am credibly informed, they will do better ^{Management of the Dairy.} than ~~where they are now~~ pluck them, if they are properly done, as they lose their feathers by moulting, and would not be so healthy.

"It is proved, that by annually plucking geese, as in Lincolnshire, there is saved, by the increase of feathers, many hundred pounds value which other countries waste, through a mistaken opinion, as not an object worth their attention. Goose feathers are now sold at 18s. a stone, that used about 25 years ago to be bought at 10s. or 11s. in that county.

"A goose will produce by this method about 1s. 6d. annually of good feathers and quills."

SECT. VII.

OF THE MANAGEMENT OF THE DAIRY.

IN all but the richest corn countries, this is a most im- ^{Importance of the dairy.} portant branch of the business of a husbandman. It includes not only the proper method of preserving milk in a wholesome and uncorrupted state, but also the manufacturing from it the two valuable articles of butter and cheese.

Dr James Anderson remarks, that when a dairy is ^{Principles on which a dairy ought to be managed.} established, the undertaker may sometimes think it his interest to obtain the greatest possible quantity of produce; sometimes it may be more beneficial for him to have it of the finest quality; and at other times it may be necessary to have both these objects in view, the one or the other in a greater or less proportion: it is there-
fore

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ment of the
Dairy.

fore of importance that he should know how he may accomplish the one or the other of these purposes in the easiest and most direct manner.

To be able to convert his milk to the highest possible profit in every case, he ought to be fully acquainted with every circumstance respecting the manufacture both of butter and of cheese; as it may in some cases happen, that a certain portion of ~~raw~~ milk may be more advantageously converted into butter than into cheese, while another portion of it would return more profit if made into cheese.

The first thing to be adverted to, in an undertaking of this nature, is to choose cows of a proper sort. Among this class of animals, it is found by experience, that some kinds give milk of a much thicker consistence and richer quality than others; nor is this richness of quality necessarily connected with the smallness of the quantity yielded by cows of nearly an equal size; it therefore behoves the owner of a dairy to be peculiarly attentive to this circumstance. In judging of the value of a cow, it ought rather to be the quantity and the quality of the cream produced from the milk of the cow, in a given time, than the quantity of the milk itself: this is a circumstance undoubtedly of more importance than is generally imagined. The small cows of the Alderney breed afford the richest milk hitherto known; but individual cows in every country may be found, by a careful selection, that afford much thicker milk than others; these therefore ought to be searched for with care, and their breed reared with attention, as being peculiarly valuable.

Few persons, who have had any experience at all in the dairy, can be ignorant, however, that in comparing
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the milk of two cows, to judge of their respective qualities, particular attention must be paid to the time that has elapsed since their calving; for the milk of the same cow is always thinner soon after calving than it is afterwards; as it gradually becomes thicker, though generally less in quantity, in proportion to the time since the cow has calved. The colour of the milk, soon after calving, is richer than it is afterwards; but this, especially for the first two weeks, is a faulty colour, that ought not to be coveted.

To enable cows to give abundance of milk and of good quality, they must at all times have plenty of food. Mr Young remarks, that there are some farms peculiarly proper for cows, not more so than others on better soil, but upon which no stock will pay so well. These are particularly such as contain much rough wild pasture, too wet for sheep. Rough waste lands, quite dry, pay best under the latter animal; but when the soil is wet, they do better for cows. Farms containing much of this land suit the dairy or young cattle. Exclusive of such general instances, that concern whole farms, Mr Young observes, that the chief articles of food for a dairy of cows, beginning with summer, are,

“ 1. *Grass*.—Common meadows and pastures, not exceedingly fine, are profitably applied to this use; but it is yet a question whether cows will pay for very fine pasture that will fat a large ox. The very general application of such to fattening, usually called *grazing*, gives one reason to believe the dairy inferior on such land; my own opinion unites in this with the general practice. They reckon in Cheshire, that the worst land makes the best cheese.

“ 2. *Clver*.—There are many arable farms where considerable

Management of the Dairy.

considerable dairies are kept very much by means of this grafs. It is not so good food as common meadows and pastures that abound with various other plants; and is apt to make cheefe hove, and be full of little holes, and if not carefully made, ill tasted. Without care also, the cows burst upon being first turned in; yet, with all these objections, many hundreds of cows are almost entirely kept on it.

" 3. *Sainfoin*.—Much superior to the foregoing. It is sweeter and better food, and will enable farmers on poor, dry, barren, chalky hills, to keep great dairies, where a single cow would starve without it.

" 4. *Lucern*.—This grafs for all sorts of cattle is the best of all the artificial ones; it yields a great quantity of the richest and sweetest milk, and may be depended on from May to October with little or no variation from the season. In the most dry and burning summers the growth will be nearly as great as in wet seasons. A cow, not of the largest size, will eat from 90lb. to 110lb. of green lucern in 24 hours. Mr Baker found in Ireland that an Irish acre of this grafs would feed six cows 145 days.

" 5. *Burnet* is very much liked by cows, and yields as sweet butter as any other plant.

" 6. *Tares* mown for soiling will do for them.

Winter food of cows.

* Concerning the winter food of cattle, Mr Young remarks, that one disadvantage of having cows of a very fine breed is, that the farmer feeds them in a manner which the produce of a dairy will rarely pay for: for instance, keeping them on hay. Those who are inclined to keep great numbers of cows, should consider well in what manner they are to pay for their food: with a very slight mismanagement you may be greatly out of pocket.

pocket. It is very common to hear it asserted, that, to make money by cattle, they must be well fed : if it will not answer to feed cattle plentifully, it will not to feed them badly ; and many such wise observations, which mean little and teach less. They are very true, with given articles of food, and very false with others. From the first of November, when we may suppose a cow put to hay till May 12th, when the green fields will be ready to receive her, there are 193 days : a middling cow will eat 30lb. of hay a day, without any waste ; or in that time more than two tons and a half ;—" but ridiculous as it would be, adds this author, to feed a cow with hay through the winter, yet some of that food should be given her. After calving she ought to have it moderately ; but if more than half a ton per cow is allowed, the farmer will not gain much by his dairy ; and if you can reduce it lower by green winter food, such as cabbages, turnips, or other roots, so much the better. While dry, till a month before they calve, they are to be in the straw yard that has a pond's mouth in it ; and there let them have the straw given in cribs, in the order of its goodness, keeping the best till last, taking care to give all fresh thrashed. 1. Wheat and rye. 2. Barley, without clover amongst it. 3. Oats, ditto. 4. Pease and beans. Lastly, Barley and oats, that has much clover in it. If the cows are valuable, or the straw bad, they may have every day a bait of cabbages, turnips, &c. in bins. A month before calving they should have each 10 or 15 pounds of hay every evening, or a better allowance of green food. After they have calved, they should be well fed with green food, and for a fortnight with hay also ; and the day she calves, keep her confined, and give her warm water.

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ter. Hence if the dairy is large, you cannot do without a division in the yard or stalls, in which the food may be varied at pleasure. Remember, in general, that cattle in high case will do on worse straw than poor ones; and that Lisle's maxim has a great deal of truth in it, viz. that cattle well summered are half wintered." Mr Young considers cabbages as the most profitable green food that can be given to cows: For a middle-sized cow 70 or 80lb. a day of cabbages, with some straw, is sufficient. Many dairies are also fed largely and profitably upon turnips, of which, however, a cow will eat a larger weight than of cabbages. Carrots and potatoes he accounts the best winter food for cows, but he thinks them too costly. Malt grains are used in all great cities; they give much thin milk, that answers well in those situations where it is sold by measure."

Cows, how
to be milk-
ed.

Cows, if abundantly fed, should be milked three times a day during the whole of the summer season; in the morning early, at noon, and in the evening just before night-fall. In the choice of persons for milking the cows, great caution should be employed; for if that operation be not carefully and properly performed, not only the quantity of the produce of the dairy will be greatly diminished, but its quality also will be very much debased; for if all the milk be not thoroughly drawn from a cow when she is milked, that portion of milk which is left in the udder seems to be gradually absorbed into the system, and nature generates no more than to supply the waste of what has been taken away. If this lessened quantity be not again thoroughly drawn off, it occasions a yet farther diminution of the quantity of milk generated; and thus it may be made to proceed

proceed in perpetual progression, from little to less, till none at all is produced. In short, this is the practice in all cases followed, when it is meant to allow a cow's milk to dry up entirely, without doing her hurt. In this manner, therefore, the profits of a dairy might be wonderfully diminished; so that it much behooves the owner of it to be extremely attentive to this circumstance, if he wishes to avoid ruin. It ought to be a rule, without an exception, never to allow this important department to be intrusted, without controul, to the management of hired servants.

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Our author proceeds to enumerate the properties of a dairy. The milk-house ought to be cool in summer and warm in winter; so that an equal temperature may be preserved throughout the year. It ought also to be dry, so as to admit of being kept sweet and clean at all times. A separate building should be erected for the purpose, near a cool spring or running water, to which the cows may have easy access, and where it is not liable to be incommoded by stagnant water. The apartment where the milk stands should be well thatched, have thick walls, and a ventilator in the top for admitting a free circulation of air. There should also be an apartment with a fire-place and caldron, for the purpose of scalding and cleaning the vessels. The doctor is of opinion, that the temperature of from 50 to 55 degrees is the most proper for separating the cream from the milk, and by proper means this might easily be kept up, or nearly so, both summer and winter.

Dairy de-
scribed.

The utensils of the dairy should be all made of wood, in preference either to lead, copper, or even cast iron. These metals are all very easily soluble in acids; the solutions of the two first are highly poisonous; and though

Wooden
utensils pre-
ferable to
every other
kind.

Management of the Dairy. the latter is innocent, the taste of it might render the products disagreeable.

Having stated these general remarks upon the mode in which a dairy ought to be conducted, we shall next consider its two valuable products, *butter* and *cheese*.

I. OF BUTTER.

History of butter.

Butter, though used at present as food in most countries of Europe, was not known, or known very imperfectly, to the ancients. This, we think, is completely proved by Professor Beckmann in the second volume of his *History of Inventions*. In our translation of the Hebrew Scriptures, there is indeed frequent mention made of butter at very early periods; but, as the professor well observes, the greatest masters of biblical criticism unanimously agree, that the word so translated signifies milk or cream, or sour thick milk, and cannot possibly mean what we call *butter*. The word plainly alludes to something liquid, which was used for washing the feet, which was drank, and which had sometimes the power of intoxicating; and we know that mares milk may be so prepared as to produce the same effect.

The oldest mention of butter, the professor thinks, is in the account of the Scythians, given by Herodotus (lib. iv. 2.) who says, that “these people pour the milk of their mares into wooden vessels, cause it to be violently stirred or shaken by their blind slaves, and separate the part which arises to the surface, as they consider it as more valuable and delicious than what is collected below it”. That this substance must have been a soft kind of butter, is well known; and Hippocrates gives a similar account of Scythian butter,
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and calls it *πινεσιον*, which Galen translates by the word *βούτυρον*. The poet Anaxandrides, who lived soon after Hippocrates, describing the marriage feast of Iphicrates, who married the daughter of Cotys king of Thrace, says, that the Thracians ate butter, which the Greeks at that time considered as a wonderful kind of food.

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Dioscorides says, that good butter was prepared from the fattest milk, such as that of sheep or goats, by shaking it in a vessel till the fat was separated. To this butter he ascribes the same effects, when used externally, as those produced by our butter at present. He adds also, and he is the first writer who makes the observation, that fresh butter might be melted and poured over pulse and vegetables instead of oil, and that it might be employed in pastry in the room of other fat substances. A kind of foot likewise was at that time prepared from butter, for external applications, which was used in curing inflammation of the eyes and other disorders. For this purpose, the butter was put into a lamp, and, when consumed, the lamp was again filled, till the desired quantity of foot was collected in a vessel placed over it.

Galen, who distinguishes and confirms in a more accurate manner the healing virtues of butter, expressly remarks, that cows milk produces the fattest butter; that butter made from sheeps or goats milk is less rich; and that asses milk yields the poorest. He expresses his astonishment, therefore, that Dioscorides should say, that butter was made only from the milk of sheep and goats. He assures us, that he had seen it, made from cows milk, and that he believes it had thence acquired its name. "Butter (says he) may be very

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properly employed for ointments; and when leather is besmeared with it, the same purpose is answered as when it is rubbed over with oil. In cold countries, which do not produce oil, butter is used in the baths; and that it is a real fat, may be readily perceived by its catching fire when poured over burning coals." What has been here said is sufficient to shew that butter must have been very little known to or used by the Greeks and Romans in the time of Galen, that is, at the end of the second century.

The professor having collected, in chronological order, every thing which he could find in the works of the ancients respecting butter, concludes, that it is not a Grecian, and much less a Roman invention; but that the Greeks were made acquainted with it by the Scythians, the Thracians, and the Phrygians; and the Romans by the people of Germany. He is likewise decidedly of opinion, that when these two polished nations had learned the art of making it, they used it not as food, but only as an ointment, or sometimes as a medicine. "We never find it (says he) mentioned by Galen and others as a food, though they have spoken of it as applicable to other purposes. No notice is taken of it by Apicius; nor is there any thing said of it in that respect by the authors who treat on agriculture, though they have given us very particular information concerning milk, cheese, and oil."

The ancient Christians of Egypt burnt butter in their lamps instead of oil; and in the Roman churches, it was anciently allowed, during Christmas time, to burn butter instead of oil, on account of the great consumption of it otherwise.

Qualities of butter.

Butter is the fat, oily, and inflammable part of the milk.

milk. This kind of oil is naturally distributed though all the substance of the milk in very small particles, which are interposed betwixt the caseous and serous parts, amongst which it is suspended by a slight adhesion, but without being dissolved. It is in the same state in which oil is in emulsions: hence the same whiteness of milk and emulsions; and hence, by rest, the oily parts separate from both these liquors to the surface, and form a cream.

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When butter is in the state of cream, its proper oily parts are not yet sufficiently united together to form a homogeneous mass. They are still half separated by the interposition of a pretty large quantity of serous and caseous particles. The butter is completely formed by pressing out these heterogeneous parts by means of continued percussion. It then becomes an uniform soft mass.

Fresh butter, which has undergone no change, has scarcely any smell; its taste is mild and agreeable, it melts with a weak heat, and none of its principles are disengaged by the heat of boiling water. These properties prove, that the oily part of butter is of the nature of the fat, fixed, and mild oils, obtained from many vegetable substances by expression.

Butter, however, as it is usually prepared and sold, is never in the state of a pure oil. Even when the whole milk is most carefully and skilfully pressed out of it, the oily parts continue united with a very putrescible substance; this is the curd of the milk. Butter is poor in proportion to the quantity of curd or cheese that remains intimately united or attached to its oily particles. Cheese, on the contrary, is rich in proportion to the

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quantity of the pure butter, or of the oily part of the milk, that remains attached to it.

Butter is used in food, on account of its agreeable taste; but to be wholesome, it must be very fresh and free from rancidity, and also not fried or burnt; otherwise its acrid and even caustic acid, being disengaged, disorders digestion, renders it difficult and painful, excites acrid empyreumatic belchings, and introduces much acrimony into the blood. Some persons have stomachs so delicate, that they are even affected with these inconveniences by fresh butter and milk. This observation is also applicable to oil, fat, chocolate, and, in general, to all oleaginous matters.

Rules for
making
butter.

Dr James Anderson, whom we have already quoted, gives the following minute directions for making and preserving butter. The creaming dishes, when properly cleaned, sweet, and cool, ought to be filled with the milk as soon as it is drawn from the cow, having been first carefully strained through a cloth, or close strainer made of hair or wire: the doctor prefers silver wire to every other. The creaming dishes ought never to exceed three inches in depth; but they may be so broad as to contain a gallon and a half; when filled they ought to be put on the shelves of the milk-house, and remain there until the cream be fully separated. If the finest butter be intended, the milk ought not to stand above six or eight hours, but for ordinary butter it may stand 12 hours or more; yet if the dairy be very large, a sufficient quantity of cream will be separated in two, three, or four hours, for making the best butter. It is then to be taken off as nicely as possible by a skimming dish, without lifting any of the milk; and

and immediately after put into a vessel by itself, until a proper quantity for churning be collected. A firm, neat, wooden barrel, seems well adapted for this purpose, open at one end, and having a lid fitted to close it. A cock or spigot ought to be fixed near the bottom, to draw off any thin or serous part which may drain from the cream; the inside of the opening should be covered with a bit of fine silver-wire gauze, in order to keep back the cream while the serum is allowed to pass; and the barrel should be inclined a little on its stand, to allow the whole to run off.

The doctor contradicts the opinion, that very fine butter cannot be obtained, except from cream that is not above a day old. On the contrary, he insists, that it is only in very few cases, that even tolerably good butter can be obtained from cream that is not above one day old. The separation of butter from cream only takes place after the cream has attained a certain degree of acidity. If it be agitated before that acidity has begun to take place, no butter can be obtained, and the agitation must be continued till the time that the founness is produced; after which the butter begins to form. "In summer, while the climate is warm, the heating may be, without very much difficulty, continued until the acidity be produced, so that butter may be got: but in this case the process is long and tedious; and the butter is for the most part of a soft consistence, and tough and gluey to the touch. If this process be attempted during the cold weather in winter, butter can scarcely be in any way obtained, unless by the application of some great degree of heat, which sometimes assists in producing a very inferior kind of butter, white, hard, and brittle,

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Cream ought to be kept some time before it be made into butter.

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ment of the
Dairy.

and almost unfit for any culinary purpose whatever. The judicious farmer, therefore, will not attempt to imitate this practice, but will allow his cream to remain in the vessel appropriated for keeping it, until it has acquired the proper degree of acidity. There is no rule for determining how long it is to be kept; but our author is of opinion, that a very great latitude is allowable in this case; and that if no ferous matter be allowed to lodge among the cream, it may be kept good for making butter a great many weeks.

Of the
churn.

The churn in which butter is made likewise admits of considerable diversity; but our author prefers the old-fashioned upright churn to all others, on account of its being more easily cleaned. The labour, when the cream is properly prepared, he thinks, very trifling. Much greater nicety, he says, is required in the process of churning than most people are aware of; as a few hasty and irregular strokes will render butter bad, which otherwise would have been of the finest quality. After the process is over, the whole ought to be separated from the milk, and put into a clean dish, the inside of which, if made of wood, ought to be well rubbed with common salt, to prevent the butter from adhering to it. The butter should be pressed and worked with a flat wooden ladle or skimming dish, having a short handle, so as to force out all the milk that was lodged in the cavities of the mass. This operation requires a considerable degree of strength as well as dexterity; but our author condemns the beating up of the butter with the hand as "an indelicate and barbarous practice." In like manner he condemns the employing of cold water in this operation, to *wash* the butter as it is called. Thus, he says, the quality of it is de-
abted

Butter
ought not
to be put
into water.

based in an astonishing degree. If it is too soft, it may be put into small vessels, and these allowed to swim in a tub of cold water; but the water ought never to touch the butter. The beating should be continued till the milk be thoroughly separated, but not till the butter become tough and gluey; and after this is completely done, it is next to be salted. The vessel into which it is to be put must be well seasoned with boiling water several times poured into it: the inside is to be rubbed over with common salt, and a little melted butter poured into the cavity between the bottom and sides, so as to make it even with the bottom; and it is then fit for receiving the butter. Instead of common salt alone, the doctor recommends the following composition: "Take of sugar one part; of nitre one part; and of the best Spanish great salt, two parts. Beat the whole into fine powder, mix them well together, and put them by for use. One ounce of this is to be thoroughly mixed with a pound of butter as soon as it is freed from the milk, and then immediately put into the vessel designed to hold it; after which it must be pressed so close as to leave no air-holes; the surface is to be smoothed and covered with a piece of linen, and over that a piece of wet parchment; or, in defect of this last, fine linen that has been dipped in melted butter, exactly fitted to the edges of the vessel all round, in order to exclude the air as much as possible. When quite full, the cask is to be covered in like manner, and a little melted butter put round the edges, in order to fill up effectually every cranny, and totally to exclude the air. "If all this (says the doctor) be carefully done, the butter may be kept perfectly sound in this climate for many years; How many years I cannot

Management of the Dairy.

Composition for preserving butter.

not

Manage-
ment of the
Dairy.



not tell ; but I have seen it two years old, and in every respect as sweet and sound as when only a month old.

It deserves to be remarked, that butter cured in this manner does not taste well till it has stood at least a fortnight after being salted ; but after that period is elapsed, it eats with a rich marrowy taste that no other butter ever acquires ; and it tastes so little of salt, that a person who had been accustomed to eat butter cured with common salt only, would not imagine it had got one-fourth part of the salt necessary to preserve it." Our author is of opinion, that strong brine may be useful to pour upon the surface during the time it is using, in order the more effectually to preserve it from the air, and to avoid rancidity.

To prepare
butter for
sending to
warm cli-
mates.

As butter contains a quantity of mucilaginous matter much more putrescible than the pure oily part, our author recommends the purifying it from this mucilage by melting in a conical vessel, in which the mucilage will fall to the bottom ; the pure oily part swimming at top. This will be useful, when butter is to be sent a long voyage to warm climates, as the pure part will keep much better than when mixed with the other. He proposes another method of preserving butter, by mixing it with honey, which is very antiseptic, and mixes intimately with the butter. Thus mixed, it eats very pleasantly, and may perhaps be successfully used with a medicinal intention.

Preserved
by honey.

Epping
butter.

In England no butter is esteemed equal to that which is made in the county of Essex, well known by the name of *Epping butter*, and which in every season of the year yields at London a much higher price than any other. The following directions concerning the making and management of butter, including the Epping method

AGRICULTURE.

rhod, are extracted from the 3d volume of the Bath Society Papers. Management of the Dairy.

It sometimes happens that some of a cow's teats may be scratched or wounded so as to produce foul or corrupted milk; when this is the case, we should by no means mix it with the sweet milk, but give it to the pigs; and that which is conveyed to the dairy-house should remain in the pail till it is nearly cool, before it be strained, that is, if the weather be warm; but in frosty weather it should be immediately strained, and a small quantity of boiling water may be mixed with it, which will cause it to produce cream in abundance, and the more so if the pans or vats have a large surface.

During the hot summer months, it is right to rise with or before the sun, that the cream may be skimmed from the milk ere the dairy becomes warm; nor should the milk at that season stand longer in the vats, &c. than 24 hours, nor be skimmed in the evening till after sunset. In winter, milk may remain unskimmed for 36 or 48 hours; the cream should be deposited in a deep pan, which should be kept during the summer in the coolest part of the dairy; or in a cool cellar where a free air is admitted, which is still better. Where people have not an opportunity of churning every other day, they should shift the cream daily into clean pans, which will keep it cool, but they should never fail to churn, at least twice in the week, in hot weather; and this work should be done in a morning before the sun appears, taking care to fix the churn where there is a free draught of air. If a pump-churn be to be used, it may be plunged a foot deep into a tub of cold water, and should remain there during the whole time

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time of churning, which will very much harden the butter. A strong rancid flavour will be given to butter, if we churn so near the fire as to heat the wood in the winter season.

After the butter is churned, it should be immediately washed in many different waters till it is perfectly cleaned from the milk ; but here it must be remarked, that a warm hand will soften it, and make it appear greasy, so that it will be impossible to obtain the best price for it. The cheefemongers use two pieccs of wood for their butter ; and if those who have a very hot hand were to have such, they might work the butter so as to make it more saleable.

The Epping butter is made up for market in long rolls, weighing a pound each. In the county of Somerset, they dish it in half pounds for sale ; but if they forget to rub salt round the inside of the dish, it will be difficult to work it so as to make it appear handsome.

Those who use a pump-churn must endeavour to keep a regular stroke ; nor should they admit any person to assist them, except they keep nearly the same stroke ; for if they churn more slowly, the butter will in the winter *go back*, as it is called ; and if the stroke be more quick and violent in the summer, it will cause a fermentation, by which means the butter will imbibe a very disagreeable flavour.

Where people keep many cows, a barrel-churn is to be preferred ; but if this be not kept very clean, the bad effects will be discovered in the butter ; nor must we forget to shift the situation of the churn when we use it, as the seasons alter, so as to fix it in a warm place

place in winter, and where there is a free air in summer.

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In many parts of this kingdom they colour their butter in winter, but this adds nothing to its goodness; and it rarely happens that the farmers in or near Epping use any colour; but when they do, it is very innocent. They procure some sound carrots, whose juice they express through a sieve, and mix with the cream when it enters the churn, which makes it appear like May butter; nor do they at any time use much salt, though a little is absolutely necessary.

As they make in that country but very little cheese, so of course very little whey butter is made; nor indeed should any person make it, except for present use, as it will not keep good more than two days; and the whey will turn to better account to fatten pigs with. Nothing feeds these faster, nor will any thing make them so delicately white. At the same time it is to be observed, that no good bacon can be made from pigs thus fattened. Where much butter is made, good cheese for servants may be obtained from skimmed milk, and the whey will afterwards do for store pigs.

Cows should never be suffered to drink improper water; stagnated pools, water wherein frogs, &c. spawn, common sewers, and ponds that receive the drainings of stables, are improper.

In the Annals of Agriculture, vol. xvii. the following mode of preventing butter and cream from receiving a taint from the cows feeding on cabbages and turnips is stated by J. Jones, Esq. of Bolas-heath, Newport, Shropshire. "I find by experience (says he) that a small bit of saltpetre, powdered and put into the milk-pan, with the new milk, does effectually prevent the cream and butter

How butter may be kept untainted by cabbages and turnips.

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butter from being tainted, although the cows be fed on the refuse leaves of cabbages and turnips. In the beginning of this last winter, my men were very careful in not giving to the cows any outside or decayed leaves of the cabbages or turnips; yet the cream and butter were sadly tainted: but as soon as the maid used the saltpetre, all the taint was done away; and afterwards no care was taken in feeding the cows, for they had cabbages and turnips in all states. Our milk-pans hold about nine pints of milk."

2. OF CHEESE.

Cheese described.

The other grand object of the dairy is cheese-making. Cheese is the curd of milk, precipitated or separated from the whey by an acid. Cheese differs in quality according as it is made from new or skimmed milk, from the curd which separates spontaneously upon standing, or that which is more speedily produced by the addition of rennet. Cream also affords a kind of cheese, but quite fat and butyraceous, and which does not keep long. Analyzed chemically, cheese appears to partake much more of an animal nature than butter, or the milk from which it was made. It is insoluble in every liquid except spirit of nitre, and caustic alkaline ley. Shaved thin, and properly treated with hot water, it forms a very strong cement if mixed with quicklime. When prepared with the hot water, it is recommended in the Swedish memoirs to be used by anglers as a bait. It may be made into any form, is not softened by the cold water, and the fishes are fond of it. As a food, physicians condemn the too free use of cheese. When new, it is extremely difficult of digestion: when old, it becomes acrid and hot; and, from

from Dr Percival's experiments, is evidently of a septic nature. It is a common opinion that old cheese digests every thing, yet is left undigested itself : but this is without any solid foundation. Cheese made from the milk of sheep is digested sooner than that from the milk of cows, but is less nourishing ; that from the milk of goats digests sooner than either, but is also the least nourishing. In general, it is a kind of food fit only for the laborious, or those whose organs of digestion are strong.

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Every country has places noted for this commodity : thus Chester and Gloucester cheese are celebrated in England ; and the Parmesan cheese is in no less repute abroad, especially in France. This sort of cheese is entirely made of sweet cow-milk : but at Rochefort in Languedoc, they make it of ewes milk ; and in other places it is usual to add goat or ewes milk in a certain proportion to that of the cow. There is likewise a kind of medicated cheese made by intimately mixing the expressed juice of certain herbs, as sage, baum, mint, &c. with the curd before it is fashioned into a cheese. The Laplanders make a sort of cheese of the milk of their rein-deer ; which is not only of great service to them as food, but on many other occasions. It is a very common thing in these climates to have a limb numbed and frozen with the cold : their remedy for this is heating an iron red hot, and thrusting it through the middle of one of these cheeses : they catch what drops out, and with this anoint the limb, which soon recovers. They are subject also to coughs and diseases of the lungs, and these they cure by the same sort of medicine : they boil a large quantity of the cheese in the fresh deer's milk, and drink the decoction

Management of the Dairy. tion in large draughts warm several times a-day. They make a less strong decoction of the same kind also, which they use as their common drink, for three or four days together, at several times of the year. They do this to prevent the mischiefs they are liable to from their water, which is otherwise their constant drink, and is not good

Making of cheese. In making cheese the same precaution is to be observed as with regard to butter, viz. the milk ought not to be agitated by carrying to any distance; nor ought the cows to be violently driven before they are milked, which reduces the milk almost to the same state as if agitated in a barrel or churn. To this cause Mr Twamley, who has written a treatise upon dairy management, attributes the great difficulty sometimes met with in making the milk coagulate; four or five hours being sometimes necessary instead of one (the usual time employed); and even after all, the curd will be of such a soft nature, that the cheese will swell, puff up, and rent in innumerable places, without ever coming to that solid consistence which it ought to have. As this frequently happens in consequence of heat, Mr Twamley advises to mix a little cold spring water with the milk. It is a bad practice to put in more rennet when the curd appears difficult to be formed; for this substance, after having once formed the curd by the use of a certain quantity, will dissolve it again by the addition of more.

General defects of cheese.

The most common defects of cheese are its appearing when cut, full of small holes called *eyes*; its puffing up, cracking, and pouring out quantities of thin serous liquor; becoming afterwards rotten and full of maggots in those places from which the liquor issued. All this,

this, according to our author, proceeds from the formation of a substance called by him *slip curd*, a kind of half coagulum, incapable of a thorough union with the true curd, and which, when broken into very small bits, produces *eyes*; but if in larger pieces, occasions those rents and cracks in the cheese already mentioned: for though this kind of curd retains its coagulated nature for some time, it always sooner or later dissolves into a serous liquid. This kind of curd may be produced,

1. By using the milk too hot.
2. By bad runnet.
3. By not allowing the curd a proper time to form.

The first of these is remedied by the use of cold water, which our author says is so far from being detrimental to the quality of the cheese, that it really promotes the action of the runnet upon the milk. The second, viz. a knowledge of good and bad runnet, can only be acquired by long practice; and no particular directions can be given, farther than that the utmost care must be taken that it have no putrid tendency, nor any rancidity from too great heat in drying. The only rule that can be given for its preparation is to take out the maw of a calf which has fed entirely upon milk; after it is cold, swell it a little in water; rub it well with salt; then fill it with the same, and afterwards cover it. Some cut them open and spread them in salt, putting them in layers above one another, letting them continue in the brine they produce, sometimes stirring or turning them for four, six, or nine months; after which they are opened to dry, stretched out upon sticks or splints. They may be used immediately after being dried, though it is reckoned best to keep them till they be a year old before they are used. The best method of making the runnet from

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Of preparing runnet.

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the skins, according to our author, is the following :
 “ Take pure spring water, in quantity proportioned to the runnet you intend to make ; it is thought best by some two skins to a gallon of water ; boil the water, which makes it softer and more pure ; make it with salt into brine that will swim an egg : then let it stand till the heat is gone off to about the heat of blood-warm ; then put your maw-skin in, either cut in pieces or whole ; the former I should imagine best or most convenient ; letting it steep 24 hours, after which it will be fit for use. Such quantity, as is judged necessary, must then be put into the milk ; about a tea-cupful being necessary for ten cows milk ; though, in this respect, very particular directions cannot be given.”

Mr Hazard's receipt for runnet.

In the Bath Papers, Mr Hazard gives the following receipt for making runnet. “ When the maw-skin is well prepared and fit for the purpose, three pints or two quarts of soft water, clean and sweet, should be mixed with salt, wherein should be put sweet brier, rose leaves and flowers, cinnamon, cloves, mace, and in short, almost every sort of spice and aromatic that can be procured ; and if these are put into two quarts of water, they must boil gently till the liquor is reduced to three pints, and care should be taken that this liquor is not smoked. It should be strained clear from the spices, &c. and when found not to be warmer than milk from the cow, it should be poured upon the vell or maw. A lemon may then be sliced into it, when it may remain a day or two ; after which it should be strained again and put into a bottle, where, if well corked, it will keep good for twelve months or more. It will smell like a perfume, and a small quantity of it will turn the milk, and give the cheese a pleasing flavour.”

your." He adds, that if the vell or maw be salted, and dried for a week or two near the fire, it will do for the purpose again almost as well as before.

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In the making of cheefe, supposing the runnet to be of a good quality, the following particulars must be observed: 1. The proper degree of heat. This ought to be what is called *milk-warm*, or, "a few degrees removed from coolness," according to Mr Twamley; considerably below the heat of milk taken from the cow. If too hot, it may be reduced to a proper temperature by cold water, as already mentioned. 2. The time allowed for the runnet to take effect. This, our author observes, ought never to be less than an hour and a half. The process may be accelerated, particularly by putting salt to the milk before the runnet is added. Mr Twamley advises two handfuls to ten or twelve cows milk; but he assures us, that no bad consequence can follow from the curd being formed ever so soon; as it then only becomes more solid and fit for making cheefe of a proper quality. 3. To prevent any difficulty in separating the curd from the whey, prepare a long cheefe-knife from lath; one edge being sharpened to cut the curd across from top to bottom in the tub, crossing it with lines checkerwise: by which means the whey rises through the vacancies made by the knife, and the curd sinks with much more ease. A sieve has also been used with success, in order to separate the whey perfectly from the curd. 4. Having got the curd all firm at the bottom of the tub, take the whey from it; let it stand a quarter of an hour to drain before you put it into the vat to break it. If any bits of slip-curd swim among the whey, pour it all off together rather than

Particulars to be observed in making of cheefe.

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put it among the cheese, for the reasons already given. Some dairy-women allow the curd to stand for two hours; by which time it is become of so firm a nature that no breaking is necessary: they have only to cut it in slices, put it into the vat, and work it well by squeezing thoroughly to make it fit close; then put it into the press. Our author, however, approves more of the method of breaking the curd, as less apt to make the cheese hard and horny. 5. When the whey is of a white colour, it is a certain sign that the curd has not subsided; but if the method just now laid down be followed, the whey will always be of a green colour; indeed this colour of the whey is always a certain criterion of the curd having been properly managed. 6. The best method of preventing cheese from heaving, is to avoid making the runnet too strong, to take care that it be clean, and not tainted; to be certain that the curd is fully come, and not to stir it before the air has had time to escape; a quantity of air being always discharged in this as in many other chemical processes. 7. Cheese is very apt to split in consequence of being "salted within," especially when the vat is about half filled. In this case the curd, though separated only in a small degree by the salt, never closes or joins as it ought to do. Mr Twamley prefers salting in the milk greatly to this method. 8. Dry cracks in cheese are generally produced by keeping curd from one meal to another, and letting the first become too stiff and hard before it is mixed with the other. 9. Curdly or wrinkle-coated cheese is caused by sour milk. Cheese made of cold milk is apt to be hard, or to break and fly before the knife. 10. Such coated cheese is caused by being made

made too cold, as cheefe that is made in winter or late in autumn is apt to be, unless laid in a warm room after it is made. Management of the Dairy.

Cheese is of very different quality, according to the milk from which it is made. Thus, in Gloucestershire, what is called the *second* or *two-meal* cheese, is made from one meal of new milk and one of skimmed or old milk, having the cream taken away. Skimmed cheese, or *flet-milk* cheese, is made entirely from skimmed milk, the cream having been taken off to make butter. It goes by the name of *Suffolk cheese*, and is much used at sea; being less liable to be affected by the heat of warm climates than the other kinds. A great deal of difference, however, is to be observed in the quality of it, which our author supposes to arise chiefly from greater care being taken in some places than in others. Different kinds of cheese.

Slip-coat or soft cheese is made entirely of slip-curd, and dissolves into a kind of creamy liquor; which is a demonstration of the nature of this curd, as already mentioned. It is commonly computed, that as much milk is required to make one pound of butter as two of cheese; and even more where the land is poor, and the pastures afford but little cream.

Best methods of making cheese in England. The double Gloucester is a cheese that pleases almost every palate. The best of this kind is made from new, or (as it is called in that and the adjoining counties) *covered milk*. An inferior sort is made from what is called *half-covered milk*; though when any of these cheeses turn out to be good, people are deceived, and often purchase them for the best *covered milk cheese*, but farmers who are honest have them stamped with a piece of wood

Management of the Dairy. made in the shape of a heart, so that any person may know them.

It will be every farmer's interest (if he has a sufficient number of cows) to make a large cheese from one meal's milk. This, when brought in warm, will be easily changed or turned with the runnet; but if the morning or night's milk be to be mixed with that which is fresh from the cow, it will be a longer time before it turns; nor will it change sometimes without being heated over the fire, by which it often gets dust or foot, or smoke, which will give the cheese a very disagreeable flavour.

When the milk is turned, the whey should be carefully strained from the curd. The curd should be broken small with the hands; and when it is equally broken, it must be put by a little at a time into the vat, carefully breaking it as it is put in. The vat should be filled an inch or more above the brim, that when the whey is pressed out, it may not shrink below the brim; if it does, the cheese will be worth very little. But first, before the curd is put in, a cheese-cloth or strainer should be laid at the bottom of the vat: and this should be so large, that when the vat is filled with the curd, the ends of the cloth may turn again over the top of it. When this is done, it should be taken to the press, and there remain for the space of two hours, when it should be turned, and have a clean cloth put under it, and turned over as before. It must then be pressed again, and remain in the press six or eight hours; when it should again be turned and rubbed on each side with salt. After this it must be pressed again for the space of 12 or 14 hours more; when, if any of the edges project, they should be pared off: it may then

then be put on a dry board, where it should be regularly turned every day. It is a good way to have three or four holes bored round the lower part of the vat, that the whey may drain so perfectly from the cheese as not the least particle of it may remain. Management of the Dairy.

The prevailing opinion of the people of Gloucestershire and the neighbouring counties is, that the cheeses will spoil if they do not scrape and wash them when they are found to be mouldy. But others think, that suffering the mould to remain mellows them, provided they are turned every day. Those, however, who will have the mould off, should cause it to be removed with a clean dry flannel, as the washing the cheese is only a means of making the mould (which is a species of fungus rooted in the coat) grow again immediately.

Some people scald the curd, but this is a bad and mercenary practice; it robs the cheese of its fatness, and can only be done with a view to raise a greater quantity of whey butter, or to bring the cheeses forward for sale, by making them appear older than they really are.

As most people like to purchase high-coloured cheese, it may be right to mix a little annatto with the milk before it is turned. No cheese will look yellow without it; and though it does not in the least add to the goodness, it is perfectly innocent in its nature and effects.

Cheshire cheese is much admired; yet no people take less pains with the runnet than the Cheshire farmers. Cheshire cheese.

The following account of the mode of making this cheese is stated in the Annals of Agriculture, by Mr

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John Chamberlaine of Chester. "The procefs of making Chefhire cheefe is as follows, viz. on a farm capable of keeping 25 cows, a cheefe of about fixty pounds weight may be daily made, in the months of May, June, and July.

"The evening's milk is kept untouched until next morning, when the cream is taken off, and put to warm in a brafs pan heated with boiling water; then one-third part of that milk is heated in the fame manner, fo as to bring it to the heat of new milk from the cow; (This part of the bufinefs is done by a perfon who does not affift in milking the cows during that time.) Let the cows be milked early in the morning; then the morning's new milk and the night's milk, thus prepared, are put into a large tub together with the cream; then a portion of runnet, that has been put into water milk-warm the evening before, is put into the tub, fufficient to coagulate the milk; and, at the fame time, if arnotto be ufed to colour the cheefe, a fmall quantity, as requifite for colouring, (or a marigold or carrot infufion) is rubbed very fine, and mixed with the milk, by ftirring all together; then covering it up warm, it is to ftand about half an hour, or until coagulated; at which time it is firft turned over with a bowl, to feparate the whey from the curds, and broken foon after with the hand and bowl into very fmall particles; the whey being feparated by ftanding fome time, is taken from the curd, which finks to the bottom. The curd is then collected into a part of the tub which has a flip or loofe board acrofs the diameter of the bottom of it, for the fole ufe of feparating them; and a board is placed thereon, with weights, from fixty to a hundred and twenty pounds, to prefs out the whey. When
it

it is getting into a more solid consistence, it is cut, and turned over in slices several times, to extract all the whey, and then weighted as before; which operations may take up about an hour and a half. It is then taken from the tub, as near the side as possible, and broken very small by hand, and salted, and put into a cheese vat, enlarged in depth by a tin hoop to hold the quantity, it being more than bulk when finally put into the press. Then press the side well by hand, and with a board at top well weighted; and placing wooden skewers round the cheese to the centre, and drawing them out frequently, the upper part of the cheese will be drained of its whey: then shift it out of the vat; first put a cloth upon the top of it, and reverse it on the cloth into another vat, or the same, which vat should be well scalded before the cheese is returned into it; then the top part is broken by hand down to the middle, and salt mixed with it, and skewered as before; then pressed by hand, weighted, and all the whey extracted. This done, reverse the cheese again into another vat, warmed as before, with a cloth under it; then a tin hoop or binder is put round the upper edge of the cheese and within the sides of the vat, the cheese being first inclosed in a cloth, and the edges of it put within the vat.

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“N. B. The cloth is of fine hemp, one yard and a half long by one yard wide. It is so laid, that on one side of the vat it shall be level with the side of it, on the other it shall lap over the whole of the cheese, and the edges put within the vat: and the tin fillet to go over the whole. All the above operations will take from seven in the morning till one at noon. Finally, it is put into a press of fifteen or twenty cwt. and stuck

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stuck round the vat into the cheese with thin wire skewers, which are shifted occasionally. In four hours more, it should be shifted and turned; and in four hours more, the same, and the skewering continued. Next morning, let it be turned by the woman who attends the milk, and put under another or the same press, and so turned at night and the next morning; at noon taken out finally to the salting room, there salt the outside, and put a cloth binder round it. The cheese should, after such salting, be turned twice a-day for six or seven days, then left two or three weeks to dry, turned and cleaned every day, taken to the common cheese room, laid on straw on a boarded floor, and daily turned until grown hard.

“The room should be moderately warm; but no wind or draught of air should be permitted, which generally cracks them. Some rub the outsides with butter or oil to give them a coat.

“The spring-made cheese is often shipped for the London market in the following autumn, and it is supposed to be much ameliorated by the heating on board the vessel.”

We shall add the account given by Mr Thomas Wedge, of the manner in which they manage in Cheshire the whey that is pressed from the cheese, out of which they extract what is called *whey butter* *. “Green whey is the clear whey which is taken from the curd out of the cheese tub: the white whey is what is pressed out of the curd by the hand, &c. after being put into the cheese vat: the general term of whey is given only

* *Annals of Agriculture*, vol. xxviii.

only to such part of the liquid as remains after the ^{Management of the Dairy.} ~~fleetings~~ (made by scalding the whey) have been skimmed therefrom. In the process of making whey butter, in some instances, the (thrustings) or white whey is set in cream mugs to acidulate for churning, either by the warmth of the season, or of a room, in the same manner as for making milk butter. In other instances, the green and white whey are both boiled together for fleetings (the account of which follows): In this case, or when the green whey is boiled alone (the boiler, if an iron one, being previously rubbed with butter, to prevent the whey from catching or acquiring a burnt-like taste), such a fire is kept as will make the whey as hot as possible, without boiling; and as soon as they have acquired that degree of heat, the buttery matter, which the whey contains, will break, or separate from it, and rise to the surface. This generally takes place in the course of about an hour; but when the whey is perfectly sweet, a little souring is sometimes added to produce the breaking effect. In other respects the process of making whey-butter is the same as that of milk-butter.

“*Scalding Whey.*—The whey, when taken out of the cheese tub into brass pans or other convenient vessels, is suffered to stand about a quarter of an hour; when it is put out into other vessels, in which vessels it stands as long, and is then poured into the furnace pan. In each of these intervals it deposits a sediment of curd, which is collected in the bottom of the vessels, and returned to the mass of curd in the cheese tub.

“That whey, which drips into the tub while the cheese is pressed over it, is always kept by itself, and set by till it is, at least, a day old; as soon, therefore,

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fore, as the green whey in the furnace pan becomes so hot, as to throw up a little white froth or foam (it must not boil) the thrustings of the preceding day are put into it (unless, as before stated, they are otherwise disposed of). These cause the whey to break, and throw up a substance, something in appearance between cream and curd, which is constantly skimmed off as long as it rises, and put into the cream mugs to be churned for butter.

This whey cream, as it is called, is churned up thrice a-week, and the average produce of butter, which it yields, from one dairy cow, is from eight to ten ounces weekly. The difference of price between this and milk butter is generally from one penny to twopence per pound. As soon as the whey is exhausted of its cream, about two quarts of butter-milk are poured into it, which again breaks into what are called *fleetings* or *flit-milk*, and these are skimmed off for the use of the servants, &c.

Stilton
cheese.

But of all the cheese this kingdom produces, none is more highly esteemed than the Stilton, which is called the *Parmesan* of England, and (except faulty) is never sold for less than 1s. or 1s. 2d. per pound.

The Stilton cheeses are usually made in square vats, and weigh from six to twelve pounds each cheese. Immediately after they are made, it is necessary to put them into square boxes made exactly to fit them; they being so extremely rich, that, except this precaution be taken, they are apt to bulge out, and break asunder. They should be continually and daily turned in these boxes, and must be kept two years before they are properly mellowed for sale.

Some make them in a net somewhat like a cabbage net;

net; so that they appear, when made, not unlike an acorn. But these are never so good as the other, having a thicker coat, and wanting all that rich flavour and mellowness which make them so pleasing.

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It is proper to mention, that the making of these cheeses is not confined to the Stilton farmers, as many others in Huntingdonshire (not forgetting Rutland and Northamptonshire) make a similar sort, sell them for the same price, and give all of them the name of *Stilton cheeses*.

Though these farmers are remarked for cleanliness, they take very little pains with the runnet, as they in general only cut pieces from the vell or maw, which they put into the milk, and move gently about with the hand, by which means it breaks or turns it so, that they easily obtain the curd. They make a cheese every morning; and to this meal of new milk they add the cream taken from that which was milked the night before. This, and the age of their cheeses, have been supposed the only reasons why they are preferred to others; for, from the nicest observations, it does not appear that their land is in any respect superior to that of other counties.

Excellent cream cheeses are made in Lincolnshire, by adding the cream of one meal's milk to milk which comes immediately from the cow; these are pressed gently two or three times, turned for a few days, and are then disposed of at the rate of 1s. per pound, to be eaten while new with radishes, salad, &c.

Many people give skimmed milk to pigs, but the whey will do equally well after cheeses are made from this milk; such cheeses will always sell for, at least, 2d. per pound, which will amount to a large sum annually, where

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where they make much butter. The peasants and many of the farmers in the north of England never eat any better cheese; and though they appear harder, experience hath proved them to be much easier of digestion than any new milk cheeses. A good market may always be found for the sale of them at Bristol.

Parmesan
cheese.

Account of the making of Parmesan Cheese by Mr Zappa of Milan, in answer to Queries from Arthur Young, Esq.

From the middle of April, or sooner if possible, the cows are sent to pasture in the meadows till the end of November usually. When the season is past, and snow comes, they are put into stables for the whole winter, and fed with hay. Between nine and ten in the morning the cows are sent to water, and then to the pastures, where they remain four or five hours at most, and at three or four o'clock are driven to the stables, if the season is fresh, or under porticoes, if hot; where for the night, a convenient quantity of hay is given them. No owner will leave his cattle, without great cause, in uncovered places at night. It happens only to the shepherds from the Alps, when they pass, because it is impossible to find stables for all their cattle. For a dairy farm of 100 cows, which yields daily a cheese weighing 70 or 75 lb. of 28 ounces, are wanted 1000 perticas of land. Of these about 800 are standing meadows, the other 200 are in cultivation for corn and grass fields in rotation. Those that are in milk are milked morning and evening, with exception of such as are near calving.

The 100 cows form a dairy farm of a good large cheese;

cheese; it is reckoned, that 80 are in milk, and 20 with calves sucking, or near calving. They reckon one with the other about 32 boccalis of 32oz. of milk. Such is the quantity for a cheese of about 70lb. of 28 ounces. They join the evening with the morning milk, because it is fresher than if it was that of the morning and evening of the same day. The morning milk would be 24 hours old when the next morning the cheese should be made. From the evening milk all the cream possible is taken away for butter, mascarponi (cream cheese), &c. The milk of the morning ought to be skimmed slightly; but every one skims as much cream as he can. The butter is sold on the spot immediately at 24 sous: the cheese at about 28 sous. The butter loses nothing in weight; the cheese loses one-third of it, is subject to heat, and requires expences of service, attention, warehouses, &c. before it is sold; and a man in two hours makes 45 or 50lb. of butter that is sold directly. However, it is not possible to leave much cream in the milk to make Lodéfan cheese, called *grained cheese*; because if it is too rich, it does not last long, and it is necessary to consume it while young and found.

“Parmesan or Lodéfan cheese is made every day in the year with 100 cows. In winter, however, the milk being less in quantity, the cheese is of lesser weight, but certainly more delicate. The morning of the 3d of March 1786, I have seen the whole operation, having gone on purpose to the spot to see the whole work from beginning to the end. At 16 Italian hours, or ten in the morning, according to the northern way to account hours, the skimming of that morning's milk, gathered only two hours before, was finished. I did, meanwhile,
examine

Manage-
ment of the
Dairy.

Management of the Dairy. examine the boiler or pot. At the top it was eight feet (English) diameter, or thereabout; and about five feet three inches deep, made like a bell, and narrowing towards the bottom to about two and one-half feet. They joined the cream produced that morning with the other produced by the milk of the evening before. That produced by the last milk was double in quantity to that of the morning milk, because it had the whole night to unite; and that of the morning had only two hours to do it, in which it could not separate much. Of the cream, some was destined to make mascarpones (cream cheese), and they put the rest into the machine for making butter. Out of the milk of the evening before and of that morning, that was all put together after skimming, they took and put into the boiler 272 boccali, and they put under it two faggots of wood; which being burnt, were sufficient to give the milk a warmth a little superior to lukewarm. Then the boiler being withdrawn from the fire, the foreman put into it the runnet which they prepare in small balls of one ounce each, turning the ball in his hand always kept in the milk entirely covered; and after it was perfectly dissolved, he covered the boiler to keep the milk defended, that it might not suffer from the coldness of the season, particularly as it was a windy day. I went then to look on the man that was making mascarpones, &c. and then we went twice to examine if the milk was sufficiently coagulated. At the 18 hours, according to the Italian clocks, or noon, the true manufacture of cheese began. The milk was coagulated in a manner to be taken from the boiler in pieces from the surface. The foreman, with a stick that had 18 points, or rather nine small pieces of wood fixed by their

their middle in the end of it, and forming nine points on each side, began to break exactly all the coagulated milk, and did continue to do so for more than half an hour, from time to time examining it to see its state. He ordered to renew the fire, and four faggots of willow branches were used all at once: he turned the boiler that the fire might act; and then the underman began to work in the milk with a stick, like the above, but only with four small sticks at the top, forming eight points, four at each side, a span long each point. In a quarter of an hour the foreman mixed in the boiler the proper quantity of saffron, and the milk was all in knobs, and finer grained than before, by the effect of turning and breaking the coagulation, or curd, continually. Every moment the fire was renewed or fed; but with a faggot only at a time, to continue it regular. The milk was never heated much, nor does it hinder to keep the hand in it to know the fineness of the grain, which refines continually by the stick-work of the underman. It is of the greatest consequence to mind when the grain begins to take a consistence. When it comes to this state, the boiler is turned from the fire, and the underman immediately takes out the whey, putting it into proper receivers. In that manner the grain subsides to the bottom of the boiler; and leaving only in it whey enough to keep the grain covered a little, the foreman extending himself as much as he can over and in the boiler, unites with his hands the grained milk, making like a body of paste of it. Then a large piece of linen is run by him under that paste, while another man keeps the four corners of it, and the whey is directly put again into the boiler, by which is facilitated the means

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Manage-
ment of the
Dairy.

of raising the paste that is taken out of the boiler, and put for one quarter of an hour into the receiver where the whey was put before, in the same linen it was taken from the boiler; which boiler is turned again directly on the fire, to extract the *malcarpa* (whey cheese), which is a second product, eaten by poor people. After the paste remained for a quarter of an hour in that receiver, it was taken out and turned into the wooden form called *saffena*, without any thing else made than the rotundity, having neither top nor bottom. Immediately after having turned it into that round wooden form, they put a piece of wood like a cheese on it, putting and increasing gradually weights on it, which serve to force out the remnant of the whey; and in the evening the cheese so formed is carried into the warehouse, where, after 24 hours, they begin to give the salt. It remains in that warehouse for 15 or 20 days; but in summer only from 8 to 12 days. Meanwhile the air and salt form the crust to it; and then it is carried into another warehouse for a different service. In the second warehouse they turn every day all the cheeses that are not older than six months; and afterwards it is enough if they are only turned every 48 or 60 hours, keeping them clean, in particular, of that bloom which is inevitable to them, and which, if neglected, turns musty, and causes the cheese to acquire a bad smell. The Lodofan, because it is a province watered, has a great deal of meadows, and abounds with cows, its product being mostly in cheese, butter, &c. However, the province of Pavia makes a great deal of that cheese; and we, Milanese, do likewise the same from the side of Porte Tosa, Romana,

mana, Ticinese, and Vercilino, because we have fine meadows and dairy farms.

Making of
Fruit-Li-
quors.

SECT. IX.

MAKING OF FRUIT-LIQUORS.

As an object of curiosity to the public at large, and of agricultural value in certain British counties, we shall shortly notice these.

Cyder, as is well known, is made from apples, and *perry* from pears only. The general method of preparing both these liquors is very much the same; and a description will be given of the way in which these fruits are gathered, ground, and pressed. The mill is not essentially different from that of a common tanner's mill for grinding bark. It consists of a mill-stone from two and a half to four feet and a half in diameter, running on its edge in a circular stone trough, from nine to twelve inches in thickness, and from one to two tons in weight. The bottom of the trough in which this stone runs is somewhat wider than the thickness of the stone itself; the inner side of the groove rises perpendicularly, but the outer spreads in such a manner as to make the top of the trough six or eight inches wider than the bottom; by which means there is room for the stone to run freely, and likewise for putting in the fruit, and stirring it up while grinding. The bed of a middle-sized mill is about nine feet, some 10, and some 12; the whole being composed of two, three, or four stones cramped together and finished

Description
of a cyder
mill and
mill-house.

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quors.

after being cramped in this manner. The best stones are found in the forest of Dean ; generally a dark, reddish gritstone, not calcareous ; for if it were of a calcareous quality, the acid juice of the fruits would act upon it and spoil the liquor : a clean-grained grindstone grit is the fittest for the purpose. The runner is moved by means of an axle passing through the centre, with a long arm reaching without the bed of the mill, for a horse to draw by ; on the other side is a shorter arm passing through the centre of the stone, as represented in the figure. An iron bolt, with a large head, passes through an eye, in the lower part of the swivel on which the stone turns, into the end of the inner arm of the axis ; and thus the double motion of it is obtained, and the stone kept perfectly upright. There ought also to be fixed on the inner arm of the axis, about a foot from the runner, a cogged wheel working in a circle of cogs, fixed upon the bed of the mill. The use of these is to prevent the runner from sliding, which it is apt to do, when the mill is full ; it likewise makes the work more easy for the horse. These wheels ought to be made with great exactness. Mr Marshall observes, that it is an error to make the horse draw by traces : “ The acting point of draught (says he), the horse’s shoulder, ought, for various reasons, to be applied immediately at the end of the arm of the axis ; not two or three yards before it ; perhaps of a small mill near one-fourth of its circumference.” The building in which the mill is enclosed ought to be of such a size, that the horse may have a path of three feet wide betwixt the mill and the walls ; so that a middling-sized mill, with its horse-path, takes up a space of 14 or 15 feet every way. The whole dimensions of the mill-house, according

ing to our author, to render it any way convenient, are 24 feet by 20: it ought to have a floor thrown over it at the height of seven feet; with a door in the middle of the front, and a window opposite, with the mill on one side, and the press on the other side of the window. The latter must be as near the mill as convenience will allow, for the more easy conveying the ground fruit from the one to the other. The press, which is of a very simple construction, has its bed or bottom about five feet square. This ought to be made entirely either of wood or stone; the practice of covering it with lead being now universally known to be pernicious. It has a channel cut a few inches within its outer edge, to catch the liquor as it is expressed, and convey it to a lip formed by a projection on that side of the bed opposite to the mill; having under it a stone trough or wooden vessel, sunk within the ground, when the bed is fixed low, to receive it. The press is worked with levers of different lengths; first a short, and then a moderately long one, both worked by hand; and lastly, a bar eight or nine feet long worked by a capstan or windlafs. The expence of fitting up a mill-house is not very great. Mr Marshal computes it from 20l. to 25l.; and, on a small scale, from 10l. to 15l. though much depends on the distance and carriage of the stone. When once fitted up, it will last many years.

The making of the fruit-liquors under consideration requires an attention to the following particulars: I. The fruit. II. The grinding. III. Pressing. IV. Fermenting. V. Correcting. VI. Laying up. VII. Bottling. Each of which heads is subdivided into several others.

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Fruit-Liquors.

I. In the *management of the fruit*, the following particulars are to be considered.

1. The time of gathering ; which varies according to the nature of the fruit. The early pears are fit for the mill in September ; but few apples are ready for gathering before Michaelmas ; though, by reason of accidental circumstances, they are frequently manufactured before that time. For sale cyder, and keeping drink, they are suffered to hang upon the trees till fully ripe : and the middle of October is generally looked upon to be a proper time for gathering the store-apple. The criterion of a due degree of ripeness is the fruit falling from the tree : and to force it away before that time, in Mr Marshal's opinion, is robbing it of some of its most valuable particles. "The harvesting of fruit (says he) is widely different in this respect from the harvesting of grain ; which has the entire plant to feed it after its separation from the soil ; while fruit, after it is severed from the tree, is cut off from all possibility of a further supply of nourishment ; and although it may have reached its wonted size, some of its more essential particles are undoubtedly left behind in the tree." Sometimes, however, the fruits which are late in ripening are apt to hang on the tree until spoiled by frosts ; though weak watery fruits seem to be most injured in this manner ; and Mr Marshal relates an instance of very fine liquor being made from golden pippins, after the fruit had been frozen as hard as ice.

Method of
gathering
it.

2. The method of gathering. This, as generally practised, is directly contrary to the principle laid down by Mr Marshal, viz. beating them down with long slender poles. An evident disadvantage of this method is, that the fruit is of unequal ripeness ; for the apples

on the same trees will differ many days, perhaps even weeks, in their time of coming to perfection; whence some part of the richness and flavour of the fruit will be effectually and irremediably cut off. Nor is this the only evil to be dreaded; for, as every thing depends on the fermentation it has to undergo, if this be interrupted, or rendered complex by a mixture of ripe and unripe fruits, and the liquor be not in the first instance sufficiently purged from its feculencies, it is difficult to clear the liquor afterwards. The former defect the cyder-makers attempt to remedy by a mixture of brown sugar and brandy, and the latter by bullocks blood and brimstone; but neither of these can be expected to answer the purpose very effectually. The best method of avoiding the inconveniences arising from an unequal ripening of the fruit, is to go over the trees twice, once with a hook, when the fruit begins to fall spontaneously; the second time, when the latter are sufficiently ripened, or when the winter is likely to set in, when the trees are to be cleared with the poles above mentioned.

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quors.

3. Maturing the gathered fruit. This is usually done by making it into heaps; but Mr Marshall entirely disapproves of the practice; because, when the whole are laid in a heap together, the ripest fruit will begin to rot before the other has arrived at that degree of artificial ripeness which it is capable of acquiring. "The due degree of maturation of fruit for liquors (he observes) is a subject about which men differ much in their ideas. The prevailing practice of gathering into heaps until the ripest begin to rot, is wasting the best of the fruit, and is by no means an accurate criterion. Some shake the fruit, and judge by the rattling

Maturing
it, &c.

Making of Fruit-Liquors. of the kernels; others cut through the middle, and judge by their blackness; but none of these appears to be a proper test. It is not the state of the kernels but of the flesh, not of a few individuals, but of the greater part of the prime fruit, which renders the collective body fit or unfit to be sent to the mill. The most rational test of the ripeness of the fruit, is that of the flesh having acquired such a degree of mellowness, and its texture such a degree of tenderness, as to yield to moderate pressure. Thus, when the knuckle at the end of the tumb can, with moderate exertion, be forced into the pulp of the fruit, it is deemed in a fit state for grinding."

4. Preparation for the mill. The proper management of the fruit is to keep the ripe and unripe fruit separate from each other: but this cannot be done without a considerable degree of labour; for as by numberless accidents the ripe and unripe fruits are frequently confounded together, there cannot be any effectual method of separating them except by hand; and Mr Marshall is of opinion, that this is one of the grand secrets of cyder making, peculiar to those who excel in the business; and he is surpris'd that it should not before this time have come into common practice.

5. Mixing fruits for liquor. Our author seems to doubt the propriety of this practice; and informs us, that the finer liquors are made from select fruits; and he hints that it might be more proper to mix liquors after they are made, than to put together the crude fruits.

II. *Grinding*, and management of the fruit when ground.

1. For the greater convenience of putting the fruit into the mill, every mill-house should have a fruit-chamber over it, with a trap-door to lower the fruit down into the mill. The best manner in which this can be accomplished, is to have the valve over the bed of the mill, and furnished with a cloth spout or tunnel reaching down to the trough in which the stone moves. No straw is used in the lofts; but sometimes the fruit is turned. In Herefordshire, it is generally believed, that grinding the rind and seeds of the fruit, as well as the fleshy part of the pulp, is necessary towards the perfection of the cyder; whence it is necessary, that every kind of pains should be taken to perform the grinding in the most perfect manner. Mr Marshall complains, that the cyder-mills are so imperfectly finished by the workmen, that for the first *fifty years* they cannot perform their work in a proper manner. Instead of being nicely fitted to one another with the square and chisel, they are hewn over with a rough tool in such a careless manner, that horse-beans might lie in safety in their cavities. Some even imagine this to be an advantage, as if the fruit was more effectually and completely broken by rough than smooth stones. Some use fluted rollers of iron; but these will be corroded by the juice, and thus the liquor might be tinged. Smooth rollers will not lay hold of the fruit sufficiently to force it through.

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quors
Grinding.

Another improvement requisite in the cyder-mills is to prevent the matter in the trough from rising before the stone in the last stage of grinding; and a method of stirring it up in the trough more effectually than can be done at present. To remedy the former of these defects, it might perhaps be proper to grind the fruit

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fruit first in the mill to a certain degree ; and then put it between two smooth rollers to finish the operation in the most perfect manner. It is an error to grind too much at once ; as this clogs up the mill, and prevents it from going easily. The usual quantity for a middle sized mill is a bag containing four corn bushels ; but our author had once an opportunity of seeing a mill in which only half a bag was put ; and thus the work seemed to go on more easily, as well as more quickly, than when more was put in at once. The quantity put in at one time is to be taken out when ground. The usual quantity of fruit ground in a day is as much as will make three hogsheads of perry, or two of cyder.

2. Management of the ground fruit. Here Mr Marshall condemns in very strong terms the practice of pressing the pulp of the fruit as soon as the grinding is finished ; because thus neither the rind nor seeds have time to communicate their virtues to the liquor. In order to extract these virtues in the most proper manner, some allow the ground fruit to lie 24 hours or more after grinding, and even regrind it, in order to have in the most perfect manner the flavour and virtues of the seeds and rind.

Pressing,
&c.

III. *Pressing the fruit*, and management of the *residuum*. This is done by folding up the ground fruit in pieces of hair-cloth, and piling them up above one another in a square frame or mould, and then pulling down the press upon them, which squeezes out the juice, and forms the matter into thin and almost dry cakes. The first runnings come off foul and muddy ; but the last, especially in perry, will be as clear and fine as if filtered through paper. It is common to throw

throw away the residuum as useless; sometimes it is made use of when dry as fuel; sometimes the pigs will eat it, especially when not thoroughly squeezed; and sometimes it is ground a second time with water, and squeezed for an inferior kind of liquor used for the family. Mr Marshall advises to continue the pressure as long as a drop can be drawn. "It is found (says he), that even by breaking the cakes of refuse with the hands only gives the press fresh power over it; for though it has been pressed to the last drop, a gallon or more of additional liquor may be got by this means. Regrinding them has a still greater effect: In this state of the materials the mill gains a degree of power over the more rigid parts of the fruits, which in the first grinding it could not reach. If the face of the runner and the bottom of the trough were dressed with a broad chisel, and made true to each other, and a moderate quantity of residuum ground at once, scarcely a kernel could escape unbroken, or a drop of liquor remain undrawn."

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quors,

But though the whole virtue of the fruit cannot be extracted without grinding it very fine, some inconvenience attends this practice, as part of the pulp thus gets through the haircloth, and may perhaps be injurious to the subsequent fermentation. This, however, may be, in a great measure, remedied by straining the first runnings through a sieve. The whole should also be allowed to settle in a cask, and drawn off into a fresh vessel previous to the commencement of the fermentation. The reduced fruit ought to remain some time between the grinding and pressing, that the liquor may have an opportunity of forming an extract with the rind and kernels: but this must not be pushed too far,

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far, as in this case the colour of the cyder would be hurt; and the most judicious managers object to the pulp remaining longer than 12 hours without pressure. "Hence (says our author), upon the whole, the most eligible management in this stage of the art appears to be this: Grind one pressful a-day; press and regrind the residuum in the evening; infuse the reduced matter all night among part of the first runnings; and, in the morning, repress while the next pressful is grinding.

Fermenta-
tion.

IV. *Fermentation.* The common practice is to have the liquor turned; that is, put into casks or hog-heads immediately from the press, and so fill them quite full: but it is undoubtedly more proper to leave some space empty to be filled up afterwards. No accurate experiment has been made with regard to the temperature of the air proper to be kept up in the place where the fermentation goes on. Frost is prejudicial: but when the process usually commences, that is, about the middle of October, the liquor is put into airy sheds, where the warmth is scarce greater than in the open atmosphere; nay, the casks are frequently exposed to the open air, without any covering farther than a piece of tile or flat stone over the bung-hole, propped up by a wooden pin on one side to cause the rain water to run off.

In making of fruit-liquors, no ferment is used as in making of beer; though, from Mr. Marshall's account of the matter, it seems far from being unnecessary. Owing to this omission, the time of the commencement of the fermentation is entirely uncertain. It takes place sometimes in one, two, or three days; sometimes not till a week or month after turning: but it has been observed,

observed, that liquor which has been agitated in a carriage, though taken immediately from the press, will sometimes pass almost immediately into a state of fermentation. The continuance of the fermentation is no less uncertain than the commencement of it. Liquors when much agitated, will go through it perhaps in one day; but when allowed to remain at rest, the fermentation commonly goes on two or three days, and sometimes five or six. The fermenting liquor, however, puts on a different appearance according to circumstances. When produced from fruits improperly matured, it generally throws up a thick scum resembling that of malt liquor, and of a thickness proportioned to the species and ripeness of the fruit; the riper the fruit, the more scum being thrown up. Perry gives but little scum, and cyder will sometimes also do the same; sometimes it is intentionally prevented from doing it.

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quors.

After having remained some time in the fermenting vessel, the liquor is racked or drawn off from the lees and put into fresh casks. In this part of the operation also Mr Marshall complains greatly of the little attention that is paid to the liquor. The ordinary time for racking perry is before it has done hissing, or sometimes when it begins to emit fixed air in plenty. The only intention of the operation is to free the liquor from its faeces by a cock placed at a little distance from the bottom, after which the remainder is to be filtered through a canvas or flannel bag. This filtered liquor differs from the rest in having a higher colour; having no longer any tendency to ferment, but, on the contrary, checking the fermentation of that which is racked off; and if it loses its brightness, it is no longer easily

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easily recovered. A fresh fermentation usually commences after racking; and if it become violent, a fresh racking is necessary in order to check it; in consequence of which the same liquor will perhaps be racked five or six times. But if only a small degree of fermentation takes place, which is called *fretting*, it is allowed to remain in the same cask; though even here the degree of fermentation which requires racking is by no means determined. Mr Marshal informs us, that the best manufacturers, however, repeat the rackings until the liquor will lie quiet, or nearly so; and if it be found impracticable to accomplish this by the ordinary method of fermentation, recourse must be had to fumigation with sulphur, which is called *stumping* the casks. For this fumigation it is necessary to have matches made of thick linen cloth, about ten inches long, and an inch broad, thickly coated with brimstone for about eight inches of their length. The cask is then properly seasoned, and every vent, except the bung-hole, tightly stopped; a match is kindled, lowered down into the cask, and held by the end undipped until it be well lighted, and the bung be driven in; thus suspending the lighted match within the cask. Having burnt as long as the contained air will supply the fire, the match dies, the bung is raised, the remnant of the match drawn out, and the cask suffered to remain before the liquor be put into it for two or three hours, more or less according to the degree of power the sulphur ought to have. The liquor retains a smell of the sulphureous acid; but this goes off in a short time, and no bad effect is ever observed to follow.

In some places the liquor is left to ferment in open casks, where it stands till the first fermentation be pret-

ty well over; after which the froth or yeast collected upon the surface is taken off, it being supposed that it is this yeast mixing with the clear liquor which causes it to fret after racking. The fermentation being totally ceased, and the lees subsided, the liquor is racked off into a fresh cask, and the lees filtered as above directed. Our author mentions a way of fermenting fruit-liquors in broad shallow vats, not less than five feet in diameter, and little more than two feet deep; each vat containing about two hogheads. In these the liquor remains until it has done rising, or till the fermentation has nearly ceased, when it is racked off without skimming, the critical juncture being caught before the yeast fall; the whole sinking gradually together as the liquor is drawn off. In this practice also the liquor is seldom drawn off a second time.

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quors.

Cyder is made of three different kinds, viz. *rough*, *sweet*, and *of a middle richness*. The first kind being usually destined for servants, is made with very little ceremony. "If it is but *zeyder* (says Mr Marshall), and has body enough to keep, no matter for the richness and flavour. The rougher it is, the further it will go, and the more acceptable custom has rendered it not only to the workmen but to their masters. A palate accustomed to sweet cyder would judge the rough cyder of the farm-houses to be a mixture of vinegar and water, with a little dissolved alum to give it roughness." The method of producing this austere liquor is to grind the fruits in a crude under-ripe state, and subject the liquor to a full fermentation.—For the sweet liquor, make choice of the sweeter fruits; mature them fully; and check the fermentation of the liquor.—To produce liquors of a middle richness, the nature of the fruit, as well

Different
kinds of
cyder.

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quors.

well as the season in which it is matured, must be considered. The fruits to be made choice of are such as yield juices capable of affording a sufficiency both of richness and strength; though much depends upon proper management. Open vats, in our author's opinion, are preferable to close vessels.

V. *Correcting*, provincially called *doctoring*. The imperfections which art attempts to supply in these liquors are, 1. Want of strength; 2. Want of richness; 3. Want of flavour; 4. Want of colour and brightness.

Of correct-
ing or doc-
toring the
liquors.

The want of strength is supplied by brandy or any other spirit, in sufficient quantity to prevent the acetous fermentation. The want of richness is supplied by what are generally termed *sweets*, but prepared in a manner, which our author says, has never fallen under his notice. To supply the want of flavour, an infusion of hops is sometimes added, which is said to communicate an agreeable bitter, and at the same time a fragrance; whence it becomes a substitute for the juices of the rind and kernels thrown away to the pigs and poultry, or otherwise wasted. The want of colour is sometimes supplied by elder berries, but generally by burnt sugar, which gives the desired colour, and a degree of bitter which is very much liked. The sugar is prepared either by burning it on a salamander, and suffering it to drop, as it melts, into water; or by boiling it over the fire (in which case brown sugar is to be used), until it acquire an agreeable bitter; then pouring in boiling water in the proportion of a gallon to two pounds of sugar, and stir until the liquor become uniform. A pint of this preparation will colour a hog-head of cyder. Brightness is obtained by a mixture of
the

the blood of bullocks or sheep; that of swine being rejected, though it does not appear to be more unfit for the purpose than either of the other two. The only thing necessary to be done here is to stir the blood well as it is drawn from the animal, to prevent the parts from separating; and it ought to be stirred "both ways, for a quarter of an hour." The liquor, however, is not always in a proper condition for being refined with this ingredient: on which account a little of it ought frequently to be tried in a vial. A quart or less will be sufficient for a hog'shead. After the blood is poured in, the liquor should be violently agitated, to mix the whole intimately together. This is done by a stick slit into four, and inserted into the bung-hole; working it briskly about in the liquor until the whole be thoroughly mixed. In about 24 hours the blood will be subsided, and the liquor ought instantly to be racked off; as by remaining upon the blood even for two or three days, it will receive a taint not easily to be got rid of. It is remarkable, that this refinement with the blood carries down not only the feces, but the colour also; rendering the liquor, though ever so highly coloured before, almost as limpid as water. Hinglafs and eggs are sometimes made use of in fining cyder as well as wine.

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quors.

VI. The *laying up* or shutting up the cyder in close casks, according to Mr Marshall, is as little understood as any of the rest of the parts; the bungs being commonly put in at some certain time, or in some particular month, without any regard to the state the liquor itself is in. "The only criterion (says he) I have met with for judging the critical time of laying up, is when a fine white cream-like matter first begins

Of laying
up, or calk-
ing.

Making of
Fruit-Li-
quors.

to form upon the surface. But this may be too late ; it is probably a symptom, at least, of the acetous fermentation, which, if it take place in any degree, must be injurious. Yet if the casks be bunged tight, some criterion is necessary ; otherwise, if the vinous fermentation have not yet finally ceased, or should recommence, the casks will be endangered, and the liquor injured. Hence, in the practice of the most cautious manager whose practice I have had an opportunity of observing, the bungs are first driven in lightly, when the liquor is fine, and the vinous fermentation is judged to be over ; and, some time afterward, when all danger is past, to fill up the casks, and drive the bungs securely with a rag, and rosin them over at top." Most farmers are of opinion, that after the liquor is done fermenting, it ought to have something to *feed upon* ; that is, to prevent it from running into the acetous fermentation. For this purpose some put in parched beans, others egg-shells, some mutton suet, &c. Mr Marshall does not doubt, that something may be useful ; and thinks that isinglass may be as proper as any thing that can be got.

Bottling.

VII. *Bottling*. This depends greatly on the quality of the liquors themselves. Good cyder can seldom be bottled with propriety under a year old ; sometimes not till two. The proper time is, when it has acquired the utmost degree of richness and flavour in the casks ; and this it will preserve for many years in bottles. It ought to be quite fine at the time of bottling ; or if not so naturally, ought to be fined artificially with isinglass and eggs.

Of cyder-
kin.

The liquor, called *cyderkin*, *purre*, or *perkin*, is made of the murk or gross matter remaining after the cyder

is pressed out. To make this liquor, the murk is put into a large vat, with a proper quantity of boiled water, which has stood till it be cold again : if half the quantity of water be used that there was of cyder, it will be good ; if the quantities be equal, the cyderkin will be small. The whole is left to infuse 48 hours, and then well pressed ; what is squeezed out by the press is immediately tunned up and stopped ; it is fit to drink in a few days. It clarifies of itself, and serves in families instead of small beer. It will keep, if boiled, after pressure, with a convenient quantity of hops.

Making of
Fruit-Li-
quors.

We must not conclude this section without particular notice of the liquor called *cyder wine*, which is made from the juice of apples taken from the press and *boiled*, and which being kept three or four years is said to resemble Rhenish. The method of preparing this wine, as communicated by Dr Rush of America, where it is much practised, consists in evaporating, in a brewing copper, the fresh apple-juice till half of it be consumed. The remainder is then immediately conveyed into a wooden cooler, and afterwards is put into a proper cask, with an addition of yeast, and fermented in the ordinary way. The process is evidently borrowed from what has long been practised on the recent juice of the grape, under the term of *vin cuit*, or boiled wine, not only in Italy, but also in the islands of the Archipelago, from time immemorial.

Of cyder
wine, ac-
cording to
Dr Rush's
recipe.

This process has lately become an object of imitation in the cyder counties, and particularly in the west of England, where it is reported that many hundred hog-heads of this wine have already been made : and as it is said to betray no sign of an impregnation of copper

Fences. by the usual chemical tests, it is considered as perfectly wholesome, and is accordingly drunk without apprehension by the common people. Others, however, suspect its innocence; whence it appeared an object of no small moment to determine, in so doubtful a matter, whether or not the liquor acquires any noxious quality from the copper in which it is boiled. With this view Dr Fothergill * made a variety of experiments; and the result seemed to afford a strong presumption that the cyder wine *does* contain a minute impregnation of copper; not very considerable indeed, but yet sufficient, in the doctor's opinion, to put the public on their guard concerning a liquor that comes in so very "questionable a shape."

SECT. X.

OF FENCES.

Kinds of
fences enu-
merated.

WE shall conclude the present treatise by taking notice of the various kinds of fences that may be found valuable in agriculture.—Robert Somerville, Esq. of Hadlington, in a communication to the Board of Agriculture, has endeavoured to enumerate the whole simple and compound fences that are at present used. *Simple fences* are those that consist of one kind only, as a ditch, a hedge, or a wall.—*Compound fences* are made by the union of two or more of these; as a hedge and ditch, or
hedge

* *Bath Papers*, vol. v. p. 339.

Hedge and wall. The following is the list which he has Fences.
given of them :

“ *Simple Fences.*

- I. Simple ditch, with a bank on one side.
- II. Double ditch, with a bank of earth between.
- III. Bank of earth, with a perpendicular facing of sod.
- IV. Ma-ha, or sunk fence.
- V. Palings, or *timber fences*, of different kinds, viz.
 1. Simple nailed paling of rough timber.
 2. Jointed horizontal paling.
 3. Upright lath paling.
 4. Horizontal paling of young firs.
 5. Upright ditto of do.
 6. Chain fence.
 7. Net fence.
 8. Rope fence.
 9. Flake or hurdle fence.
 10. Ozier or willow fence.
 11. Fence of growing posts.
 12. Shingle fence, horizontal.
 13. Ditto upright.
 14. Warped paling.
 15. Open paling, warped with dead thorns or branches of trees.
- VI. Dead hedges, various kinds.
- VII. Live hedges.
- VIII. Walls.
 1. Dry stone wall, coped and uncoped.
 2. Stone and lime ditto, do.
 3. Stone and clay, do.
 4. Stone and clay harled, or dashed with lime.
 5. Dry stone ditto, lipped with lime.
 6. Dry

Fences.

6. Dry stone, ditto, lipped and harled.
7. Dry stone, pinned and harled.
8. Brick walls.
9. Framed walls.
10. Galloway dike or wall.
11. Turf wall.
12. Turf and stone, in alternate layers.
13. Mud walls, with straw.

“Compound Fences.”

1. Hedge and ditch, with or without paling.
2. Double ditto.
3. Hedge and bank, with or without paling.
4. Hedge in the face of a bank.
5. Hedge on the top of a bank.
6. Devonshire fence.
7. Hedge, with single or double paling.
8. Hedge and dead hedge.
9. Hedge and wall.
10. Hedge, ditch, and wall.
11. Hedge in the middle of a wall.
12. Hedge and ditch, with a row of trees.
13. Hedge, or hedge and wall, with belt of planting.
14. Hedge, with the corners planted.
15. Reed fence, or port and rail, covered with reeds.”

Ditches.

Of the nature of each of these, and the advantages attending the use of them, we shall take some short notice. The ditch, which is one of the simple fences, is most frequently considered merely as an open drain intended to relieve the soil of superfluous moisture. It is frequently also, however, made use of without any such intention, as a fence for the confinement of cattle ;
but

but it is more frequently used with the double view of Fences.
 serving as a fence, and as a drain. It is made in a variety of ways, according to the object in view. If a ditch is meant to be used merely as a drain, the earth thrown out of it ought by no means to be formed into a bank upon the side of it, because such a practice, as formerly stated, when treating of draining, has a tendency to injure its utility by cutting off its communication with one side of the field to be drained; but when a ditch is intended to be used as a fence, a different rule of proceeding must be followed. In that case, the object in view will be greatly forwarded by forming the earth taken out of the ditch into a bank upon its side, which, when added to the depth of the ditch, will form a barrier of considerable value.

Ditches are sometimes formed of an uniform breadth Single Ditches,
 at top and bottom. This kind of ditch is liable to many objections. After frosts and rains, its sides are perpetually crumbling down and falling in; and if the field in which such a ditch is placed have a considerable declivity, the bottom of the ditch will be extremely liable to be undermined by any current of water, that either permanently or casually takes place in it; at the same time, such ditches have been found very useful in low-lying clay or carse soils where the country is level. From the nature of the soil, the sides of the ditches in such situations are tolerably durable. No rapid current of water can exist to undermine them; and, by their figure, they withdraw from the plough the smallest possible portion of surface.

Other ditches are constructed wide above, with a gradual slope from both sides downwards. This form of a ditch is in general the best, where it is at all to be

Fences. used for the drainage of the field, as the sides are not so liable as in the former case to be excavated by the current of water. Hence it is more durable, and by diminishing the quantity of digging at the bottom, it is more easily executed.

A third kind of ditches are so formed as to have one side sloping, and the other perpendicular. This kind of ditch partakes of the whole perfections and imperfections of the two former. It is extremely useful, however, in fields of which sheep form a part of the stock, and where the bottom of the ditch contains a current of water; for, in such cases, when sheep tumble into a deep ditch, whose sides are pretty steep, they are very apt to perish; but by making one side of the ditch very much sloped, while the other approaches to the perpendicular, they are enabled to make their escape; while at the same time, by the bed of the stream being widened, the perpendicular side of the ditch is less liable to be undermined. When the earth taken out of a ditch is formed into a bank on one side, a projecting vacant space of six or eight inches ought always to be left between the bank and the ditch, to prevent the earth from tumbling in and filling up the ditch.

A double ditch, with a bank of earth between the two, formed out of the earth obtained by digging them, has many obvious advantages over the single ditch, when considered as a fence; for the earth taken out of the two ditches, when properly laid up in the middle, will naturally become a very formidable rampart, which cattle will not readily attempt to cross. It is also excellently adapted for the purpose of open drainage, and it ought always to be used upon the sides of highways, where

Where the adjoining lands have a considerable declivity towards the road. In such cases, the inner ditch receives the water from the field, and prevents it from washing down or overflowing the road in the time of heavy rains; an inconvenience which frequently cannot otherwise be avoided.

Fences.

The bank of earth, with a perpendicular facing of sod, and a slope behind, is useful in some situations, as in making folds for the confinement of sheep or cattle, in which case the front or perpendicular side of the bank must be turned inwards. It is also valuable on the sides of highways to protect the adjoining fields, and also for fencing belts of planting, or enclosing stack-yards and cottages. The front of the bank is made with the turfs taken from the surface of the sloping ditch, and the mound at the back with the earth taken out of it. This fence, when well executed, is said to last a considerable time.

Bank of earth.

The ha-ha, or sunk fence, very nearly resembles the mound of earth with the perpendicular facing of turf, with this difference, that the facing of the ha-ha is of stone. The height of both depends almost entirely upon the depth of the ditch; both of them in truth consist of the kind of ditch already mentioned, of which the one side slopes while the other is perpendicular, and differ from it chiefly in this respect, that the perpendicular side is faced with turf or stone. The stone-facing is made either of dry stone, or of stone and lime. In the Agricultural Report of Cromarty, the mode of making the sunk fence is thus described: "Upon the line where this fence is intended, begin to sink your ditch, taking the earth from as far as eight feet outward, and throwing it up on the inside of the lines.

The ha-ha, or sunk fence.

This

Fences.

This ditch and bank is not made quite perpendicular, but inclining inward towards the field as it rises; to this is built a facing of dry stone, four feet and a half in height, one foot and three quarters broad at bottom, and one foot at top, over which a coping of turf is laid: the ditch or funk part forms an excellent drain. The whole of this is performed, when the stone (we shall suppose) can be procured at a quarter of a mile's distance, for 6d. per yard." The principal defect of the funk fence consists in this, that unless the bank at the back of it is considerably steep, or has a railing at the top, it forms a kind of snare on that side for cattle, as they must always be apt to tumble over it in dark nights.

Paling.

Palings or timber fences are, in many places, much used, though they never can be considered with propriety as forming permanent enclosures. Of whatever materials they are formed their decay commences from the instant they are erected. This decay begins with the part of the paling that is put into the ground, which is speedily rotted by the moisture, or consumed by worms or other animals that attack it. To guard as much as possible against this cause of decay, various devices have been adopted. It is a very general practice to burn the surface of that part of the standards of the paling which is meant to be driven into the earth. It is also customary to cover the same part of the wood with a strong coat of coarse oil paint, and Lord Donald's coal varnish has been recommended with this view. The points of the standards that are to be fixed in the earth, ought to be dipped in the varnish while it is boiling hot. Common tar or melted pitch have also been used with tolerable success to defend the extremities of the standards of paling. In some cases, where

where the expence could be afforded, large stones have been sunk into the earth, with holes cut into them of a size adapted to receive the ends of the posts of the paling. The durability of the wood in this case is greater, but it bears no proportion to the additional expence incurred. When posts for paling can be obtained consisting of branches of trees, with the bark still upon them, this natural covering enables them to remain uncorrupted for a longer period than can be accomplished by any artificial coating. It is no objection to this, that a part of the uncovered wood, or the bottom of the stake or post must be inserted in the earth; for it is not at the bottom the stakes or posts begin to decay, but at the uppermost place at which the earth touches them, or between the wet and the dry as it is called. Of the kinds of paling it is unnecessary to say much.

Fences.

The simple nailed paling of rough timber, consists of posts or stakes inserted in the earth, and crossed with three, four, or more horizontal bars or slabs, as they are called in Scotland. It is the most common of all, and is used to protect young hedges, or to strengthen ditches when used as fences.

The jointed horizontal paling consists of massy square poles driven into the earth, and having openings cut into them for the reception of the extremities of the horizontal bars. These openings, however, weaken the poles much, and cause them soon to decay; but this kind of paling has a very handsome and substantial appearance.

The upright lath paling is formed by driving strong piles of wood into the earth, and crossing these at top and bottom, with horizontal pieces of similar strength.

Upon

Fences. Upon these last are nailed, at every 6 or 12 inches distance, laths or pieces of fawn wood, of the shape and size of the laths used for the roofs of tiled houses. This kind of paling prevents cattle from putting their heads through to crop or injure young hedges or trees.

The horizontal paling of firs or the weedlings of other young trees, does not differ from the palings already described, unless in this respect, that the materials of which it is formed, consist not of timber cut down for the purpose, but of the thinnings of woods or belts of planting. Such palings are usually more formidable to cattle than any other, because, when the lateral twigs that grow out of large branches are lopped off in a coarse manner, the branch still retains a roughness which keeps cattle at a distance.

**Chain
fence.**

The chain horizontal fence is made by fixing strong piles of wood in the earth in the direction in which the fence is to run, and fixing three chains at regular distances, extending horizontally from pile to pile, instead of cross bars of wood. Instead of posts of wood, pillars of mason work are sometimes used, and between these the chains are extended. A chain fence will confine horses or cattle, but is unfit to confine sheep or hogs. From its expensive nature, it can only be used in public walks, or for stretching across streams or pieces of water, where the enclosure can be completed in no other way.

The net fence is used for pleasure ground, and instead of chains, as in the former case, it consists of a strong net extended between upright piles. Such a fence may be a very pretty ornament, but could be of little use against the horns of cattle.

The rope fence is constructed like the chain fence,
and

and differs from it only in the use of cords instead of metal chains, and has the same defect of being useless against wine and sheep. Fences.

The moveable wooden fence, or flake or hurdle fence, consists of a kind of moveable paling, used for confining sheep or cattle to a certain spot when feeding upon a turnip field; and, in this view, it is extremely useful: for if the cattle were allowed to range at large over the field, a great quantity of the turnips would be destroyed by having pieces eaten from them, which would immediately spoil and rot before the remainder could be consumed; whereas, by the use of those moveable palings, the sheep or cattle having only a certain quantity of food allotted to them at a time, are compelled to eat it clean up without any loss. Hurdle fence.

The osier or willow fence, or wattled fence, is made by driving, in the direction of the fence, stakes of willow or poplar, of half the thickness of a man's wrist, into the earth, about 18 inches asunder. They are then bound together with small twigs of the willows or poplars twisted and interwoven with them. If the upright stakes have been recently cut down, and if the fence is made about the end of autumn, they will take root and grow in the spring. If their new lateral branches are afterwards properly interwoven and twisted together, they will become in two or three years a permanent and almost impenetrable fence. Live fences.

The paling of growing trees, or rails nailed to growing posts, is formed by planting beech, larch, or other trees, at the distance of a yard from each other, in the direction in which the fence is wanted. When 10 or 12 feet high, they must be cut down to 6 feet. The cutting of the tops will make them push out a great

Fences. number of lateral branches, which may be interwoven with the upright part of the tree, as in the case of the willow fence already mentioned.

Shingle fence. The horizontal and upright shingle fence is formed in this manner; stout piles are driven into the earth, and deals of from half an inch to an inch thick, are nailed horizontally upon them, in such a way, that the under edge of the uppermost deal projects over the upper edge of the one immediately below it, like slates or tiles upon houses. In like manner, the shingles or boards may be placed perpendicularly, and bound together by being nailed to horizontal bars of wood.

The warped paling consists of pieces of wood driven into the earth, which are twisted and interwoven with each other, so as to form a very open net-work; the tops of the pieces of wood being bound together by willow or other twigs.

The light open fence with thorns, or branches of trees wove into it, is nothing more than a common paling, whose interstices are filled up with thorns or branches of trees. It is a very effectual fence while it lasts.

Dead hedges, &c. Dead hedges are made of the prunings of trees or the tops of live hedges that have been cut down. They are sometimes made upon the top of the mound of earth taken out of a ditch, by inserting the thick ends of the twigs in the earth, and making them rest in an oblique manner. Sometimes the stronger pieces or stakes are fixed in the earth, and the smaller twigs are used to fasten them together at top, by a kind of net-work. What is called the stake and rut fence in Scotland, consists of a dead hedge or fence, formed of upright posts, the intervals between which are filled up with

with twigs woven horizontally. All these, however, can only be regarded as fences of a very temporary nature, which are constantly in want of repairs, and therefore requiring a continual expence. Fences.

Before planting live hedges, it is proper to consider the nature of the land, and what sorts of plants will thrive best in it; and also, what is the soil from whence the plants are to be taken. As for the size, the sets ought to be about the thickness of one's little finger, and cut within about four or five inches of the ground; they ought to be fresh taken up, straight, smooth, and well-rooted. Those plants that are raised in the nursery are to be preferred. General directions for planting hedges.

In planting outside hedges, the turf is to be laid with the grass-side downwards, on that side of the ditch on which the bank is designed to be made; and some of the best mould should be laid upon it to bed the quick, which is to be set upon it a foot asunder. When the first row of quick is set, it must be covered with mould; and when the bank is a foot high, you may lay another row of sets against the spaces of the former, and cover them as you did the others: the bank is then to be topped with the bottom of the ditch, and a dry or dead hedge laid, to shade and defend the under-plantation. Stakes should then be driven into the loose earth, so low as to reach the firm ground; these are to be placed at about two feet and a half distance: and in order to render the hedge yet stronger, you may edder it, that is, bind the top of the stakes with small long poles, and when the eddering is finished, drive the stakes anew.

The quick must be kept constantly weeded, and secured from being cropped by cattle; and in February Of managing the hawthorn.
it

Fences. it will be proper to cut it within an inch of the ground, which will cause it strike root afresh, and help it much in the growth.

Of the crab. The crab is frequently planted for hedges; and if the plants are raised from the kernels of the small wild crabs, they are much to be preferred to those raised from the kernels of all sorts of apples without distinction; because the plants of the true small crab never shoot so strong as those of the apples, and may therefore be better kept within the proper compass of a hedge.

Black thorn. The black thorn, or floe, is frequently planted for hedges; and the best method of doing it, is to raise the plants from the stones of the fruit, which should be sown about the middle of January, if the weather will permit, in the place where the hedge is intended; but when they are kept longer out of the ground, it will be proper to mix them with sand, and keep them in a cool place. The same fence will do for it when sown, as when it is planted.

Holly. The holly is sometimes planted for hedges; but where it is exposed, there will be great difficulty in preventing its being destroyed: otherwise, it is by far the most beautiful plant; and, being an evergreen, will afford much better shelter for cattle in winter than any other sort of hedge. The best method of raising these hedges is to sow the stones in the place where the hedge is intended; and, where this can be conveniently done, the plants will make a much better progress than those that are transplanted: but these berries should be buried in the ground several months before they are sown. The way to do this, is to gather the berries about Christmas, when they are usually ripe, and

and put them into large flower-pots, mixing some sand with them; then dig holes in the ground, into which the pots must be sunk, covering them over with earth, about ten inches thick. In this place they must remain till the following October, when they should be taken up, and sown in the place where the hedge is intended to be made. The ground should be well trenched, and cleared from the roots of all bad weeds, bushes, trees, &c. Then two drills should be made, at about a foot distance from each other, and about two inches deep, into which the seeds should be scattered pretty close, lest some should fail. When the plants grow up, they must be carefully weeded: and if they are designed to be kept very neat, they should be cut twice a year, that is, in May and in August; but if they are only designed for fences, they need only be sheered in July. The fences for these hedges, while young, should admit as much free air as possible; the best sort are those made with posts and rails, or with ropes drawn through holes made in the posts; and if the ropes are painted over with a composition of melted pitch, brown Spanish colour and oil, well mixed, they will last several years.

Hedges for ornament in gardens are sometimes planted with evergreens, in which case the holly is preferable to any other: next to this, most people prefer the yew; but the dead colour of its leaves renders those hedges less agreeable. The laurel is one of the most beautiful evergreens; but the shoots are so luxuriant that it is difficult to keep it in any tolerable shape; and as the leaves are large, to prevent the disagreeable appearance given them by their being cut through with the sheers, it is best to prune

Fences.

Of garden
hedges.

Fences.

them with the knife, cutting the shoots just down to a leaf. The *laurustinus* is a very fine plant for this purpose; but the same objection may be made to this as to the laurel: this, therefore, ought only to be pruned with a knife in April when the flowers are going off; but the new shoots of the same spring must by no means be shortened. The small-leaved and rough-leaved *laurustinus* are the best plants for this purpose. The true *phillyrea* is the next best plant for hedges, which may be led up to the height of 10 or 12 feet; and if they are kept narrow at the top, that there may be not too much width for the snow to lodge upon them, they will be close and thick, and make a fine appearance. The *ilex*, or evergreen oak, is also planted for hedges, and is a fit plant for those designed to grow very tall. The deciduous plants usually planted to form hedges in gardens are, the hornbeam, which may be kept neat with less trouble than most other plants. The beech, which has the same good qualities as the hornbeam; but the gradual falling of its leaves in winter causes a continual litter. The small-leaved English elm is a proper tree for tall hedges, but these should not be planted closer than eight or ten feet. The lime-tree has also been recommended for the same purpose; but after they have stood some years, they grow very thin at bottom, and their leaves frequently turn of a black disagreeable colour.

Of flowering shrubs.

Many of the flowering shrubs have also been planted in hedges, such as roses, honeysuckles, sweet briars, &c. but these are difficult to train; and if they are cut to bring them within compass, their flowers, which are their greatest beauty, will be entirely destroyed. A
correspondent

correspondent of the society for improving agriculture in Scotland, however, informs us, that he tried with success the eglantine, sweet-briar, or dog-rose, when all the methods of making hedges practised in Essex and Hampshire had been tried in vain. His method was to gather the hips of this plant, and to lay them in a tub till March: the seeds were then easily rubbed out; after which they were sowed in a piece of ground prepared for garden pease. Next year they came up, and the year after they were planted in the following manner. After marking out the ditch, the plants were laid about 18 inches asunder upon the side grafs, and their roots covered with the first turfs that were taken off from the surface of the intended ditch. The earth side of these turfs was placed next to the roots, and other earth laid upon the turfs which had been taken out of the ditch. In four or five years these plants made a fence which neither horses nor cattle of any kind could pass. Even in two or three years none of the larger cattle will attempt a fence of this kind. Sheep indeed will sometimes do so, but they are always entangled to such a degree, that they would remain there till they died unless relieved. Old briars dug up, and planted soon, make an excellent fence; and, where thin, it may be easily thickened by laying down branches, which, in one year, will make shoots of six or seven feet. They bear clipping very well.

Dr Anderson, who hath treated the subject of hedg-
ing very particularly, is of opinion, that some other
plants besides those above mentioned might be usefully
employed in the construction of hedges. Among these

Dr Anderson's directions.

Fences. he reckons the common willow*. This, he says, by no means requires the wetness of soil which is commonly supposed. "It is generally imagined (says he), that the willow can be made to thrive nowhere except in wet or boggy ground: but this is one of those vulgar errors, founded upon inaccurate observation, too often to be met with in subjects relating to rural affairs; for experience has sufficiently convinced me, that this plant will not only grow, but thrive, in any rich well cultivated soil (unless in particular circumstances that need not here be mentioned), even although it be of a very dry nature. It could not, however, in general be made to thrive, if planted in the same manner as thorns; nor would it, in any respect, be proper to train it up for a fence in the same way as that plant. Of the willow. The willow, as a fence, could seldom be successfully employed, but for dividing into separate inclosures any extensive field of rich ground: and, as it is always necessary to put the soil into as good order as possible before a hedge of this kind is planted in it, the easiest method of putting it into the necessary high tilth, will be to mark off the boundaries of your several fields in the winter, or early in the spring, with a design to give a complete fallow to a narrow ridge, six or eight feet broad, in the middle of which the hedge is intended to be planted the ensuing winter. This ridge ought to be frequently ploughed during the summer season, and in the autumn to be well manured with dung or lime, or both (for it cannot be made too rich), and be neatly formed into a ridge before winter.

" Having

* *Essay on Agriculture*, vol. i, p. 54. &c.

“ Having prepared the ground in this manner, it will be in readiness to receive the hedge, which ought to be planted as early in winter as can be got conveniently done ; as the willow is much hurt by being planted late in the spring.”

Fences.

The same author also gives the following useful directions for planting hedges in situations very much exposed to the weather, and recovering them when on the point of decaying. “ Those who live in an open uncultivated country, have many difficulties to encounter, which others who inhabit more warm and sheltered regions never experience ; and, among these difficulties, may be reckoned that of hardly getting hedges to grow with facility. For, where a young hedge is much exposed to violent and continued gusts of winds, no art will ever make it rise with so much freedom, or grow with such luxuriance, as it would do in a more sheltered situation and favourable exposure.

Of planting hedges in exposed situations, and recovering them when decayed.

“ But although it is impossible to rear hedges in this situation to so much perfection as in the others, yet they may be reared even there, with a little attention and pains, so as to become very fine fences.

“ It is adviseable in all cases, to plant the hedges upon the face of a bank ; but it becomes absolutely necessary in such an exposed situation as that I have now described : for the bank, by breaking the force of the wind, screens the young hedge from the violence of the blast, and allows it to advance, for some time at first, with much greater luxuriance than it otherwise could have done.

“ But as it may be expected soon to grow as high as the bank, it behoves the provident husbandman to prepare for that event, and guard, with a wise forecast,

Fences. against the inconvenience that may be expected to arise from that circumstance.

“ With this view, it will be proper for him, instead of making a single ditch, and planting one hedge, to raise a pretty high bank, with a ditch on each side of it, and a hedge on each face of the bank ; in which situation, the bank will equally shelter each of the two hedges while they are lower than it ; and, when they at length become as high as the bank, the one hedge will in a manner afford shelter to the other, so as to enable them to advance with much greater luxuriance than either of them would have done singly.

“ To effectuate this still more perfectly, let a row of service trees be planted along the top of the bank, at the distance of 18 inches from each other, with a plant of eglantine between each two services. This plant will advance, in some degree, even in this exposed situation ; and by its numerous shoots, covered with large leaves, will effectually screen the hedge on each side of it, which, in its turn, will receive some support and shelter from them ; so that they will be enabled to advance all together, and form, in time, a close, strong, and beautiful fence.

Service
tree.

“ The *service* is a tree but little known in Scotland, although it is one of those that ought, perhaps, to be often cultivated there in preference to any other tree whatever, as it is more hardy, and, in an exposed situation ; affords more shelter, to other plants, than almost any tree I know ; for it sends out a great many strong branches from the under part of the stem, which, in time, assume an upright direction, and continue to advance with vigour, and carry many leaves to the very bottom, almost as long as the tree exists ; so that if it is

not

not pruned, it rises a large close bush, till it attains the Fences.
height of a forest tree.

“ It is of the same genus with the mountain ash, or rawn-tree, and has a great resemblance to it both in flower and fruit; its branches are more waving and pliant; its leaves undivided, broad, and round, somewhat resembling the elm, but white and mealy on the under side. It deserves to be better known than it is at present.

“ But if, from the poorness of the soil in which your hedge is planted, or from any other cause, it should so happen, that, after a few years, the hedge becomes sickly, and the plants turn poor and stunted in appearance, the easiest and only effectual remedy for that disease, is to cut the stems of the plants clean over, at the height of an inch or two above the ground; after which they will send forth much stronger shoots than they ever would have done without this operation. And if the hedge be kept free from weeds, and trained afterwards in the manner above described, it will, in almost every case, be recovered, and rendered fresh and vigorous.

“ This amputation ought to be performed in autumn, or the beginning of winter; and in the spring, when the young buds begin to show themselves, the stumps ought to be examined with care, and all the buds be rubbed off, excepting one or two of the strongest and best placed, which should be left for a stem. For if the numerous buds that spring forth round the stem are allowed to spring up undisturbed, they will become in a few years as weak and stunted as before; and the hedge will never afterwards be able to attain any considerable height, strength, or healthfulness.—I have seen many

Fences. hedges, that have been repeatedly cut over, totally ruined by this circumstance not having been attended to in proper time.

“If the ground for 16 or 20 feet on each side of the hedge be fallowed at the time that this operation is performed, and get a thorough dressing with rich manures, and be kept in high order for some years afterwards by good culture and meliorating crops, the hedge will prosper much better than if this had been omitted; especially if it had been planted on the level ground, or on the bank of a shallow ditch.”

**Of the
black alder.**

Mr Miller greatly recommends the black alder as superior to any other that can be employed in moist soils. It may either be propagated by layers or truncheons about three feet long. The best time for planting these last is in February or the month of March. They ought to be sharpened at their largest end, and the ground well loosened before they are thrust into it, lest the bark should be torn off, which might occasion their miscarriage. They should be set at least two feet deep, to prevent their being blown out of the ground by violent winds after they have made strong shoots; and they should be kept clear of tall weeds until they have got good heads, after which they will require no farther care. When raised by laying down the branches, it ought to be done in the month of October; and by that time twelvemonth they will have roots sufficient for transplantation, which must be done by digging a hole and loosening the earth in the place where the plant is to stand. The young sets must be planted at least a foot and a half deep; and their top should be cut off to within about nine inches of the ground; by which means they will shoot out
many

many branches. This tree may be trained into very ^{Fences.} thick and close heges, to the height of 20 feet and upwards. It will thrive exceedingly on the sides of brooks; for it grows best when part of its roots are in water; and may, if planted there, as is usual for willows, be cut for poles every fifth or sixth year. Its wood makes excellent pipes and staves; for it will last a long time under ground or in water: and it is likewise in great estimation among plough-wrights, turners, &c. as well as for making several of the utensils necessary for agriculture. Its bark also dies a good black.

The birch is another tree recommended by Mr Mil-^{Of the}ler as proper for hedges; and in places where the ^{birch.} young plants can be easily procured, he says, that the plantation of an acre will not cost 40 shillings, the after expence will not exceed 20 shillings: so that the whole will not come above three pounds. Ash trees ought never to be permitted in hedges, both because they injure the corn and grafs by their wide extended roots, and likewise on account of the property their leaves have of giving a rank taste to butter made from the milk of such cattle as feed upon the leaves. No ash trees are permitted to grow in the good dairy countries.

Where there is plenty of rough flat stones, the ^{Of hedges} fences which bound an estate or farm are frequently ^{raised on} made with them. In Devonshire and Cornwall it is ^{the top of} common to build, as it were, two walls with these stones ^{stone} laid upon one another; first two and then one be-^{fences.}tween: as the wall rises they fill the intermediate space with earth, beat the stones in flat to the sides, which makes them lie very firm, and so proceed till the whole

Fences. whole is raised to the intended height. Quick hedges, and even large timber trees, are planted upon these walls, and thrive extremely well. Such enclosures are reckoned the best defence that can be had for the ground and cattle; though it can scarce be supposed but they must be disagreeable to the eye, and stand in need of frequent repairs, by the stones being forced out of the way by cattle. The best way to prevent this is to build such wall in the bottom of a ditch made wide enough on purpose, and sloped down on each side. Thus the deformity will be hid; and as the cattle cannot stand to face the wall so as to attempt to leap over it, the stones of which it is composed will be less liable to be beaten down. The earth taken out of the ditch may be spread on the adjacent ground, and its sides planted with such trees or underwood as will best suit the soil. By leaving a space of several feet on the inside for timber, a supply of that valuable commodity may be had without doing any injury to the more valuable pasture.

Method of
construct-
ing an ex-
cellent
fence in
grassy places.

The following is an excellent method of making a durable and beautiful fence in grassy places. Dig pieces of turf four or five inches thick, the breadth of the spade, and about a foot in length. Lay these turfs even by a line on one side, with the grass outward, at the distance of ten or twelve inches within the mark at which the ditch afterwards to be dug in the solid ground is to begin. Then lay, in the same manner, but with their grass sides turned out the contrary way, another row of turfs, at such a distance as to make a breadth of foundation proportioned to the intended height of the bank. Thus, even though the ground should prove defective, the bank would be prevented from

from giving way. A ditch may then be dug of what Fences.
depth and breadth you please; or the ground may be lowered with a slope on each side; and, in this case, there will be no loss of pasture by the fence; because it may be sowed with hay-seeds, and will bear grass on both sides. Part of the earth taken out of the ditches or slopes will fill the chasm between the rows of turf, and the rest may be scattered over the adjacent ground. Three, four, or more layers of turf, may be thus placed upon one another, and the interval between them filled up as before till the bank is brought to its desired height; only observing to give each side of it a gentle slope for greater strength. The top of this bank should be about two feet and a half wide, and the whole of it filled up with earth, except a small hollow in the middle to retain some rain. Quicksets should then be planted along this top, and they will soon form an admirable hedge. By this means a bank four feet high, and a slope only two feet deep, will make, beside the hedge, a fence six feet high, through which no cattle will be able to force their way: for the roots of the grass will bind the turf so together, that in one year's time it will become entirely solid; and it will yet be much stronger when the roots of the quick shall have shot out among it. The only precautions necessary to be observed in making this bank are, 1. Not to make it when the ground is too dry; because, if a great deal of wet should suddenly follow, it will swell the earth so much as, perhaps, to endanger the falling of some of the outside; which, however, is easily remedied if it should happen. 2. If the slope be such as sheep can climb up, secure the young quicks, at the time of planting them, by a small
dead

Fences. dead hedge, either on or near the top, on both sides. If any of the quick should die, which they will hardly be more apt to do in this than in any other situation, unless perhaps in extremely dry seasons, they may be renewed by some of the methods already mentioned. Such fences will answer even for a park; especially if we place posts and rails, about two feet high, a little sloping over the side of the bank, on or near its top: no deer can creep through this, nor even be able to jump over it. It is likewise one of the best fences for securing cattle; and if the quicks on the banks be kept clipped, it will form a kind of green wall pleasing to the eye.

Elms recommended.

In the first volume of the Bath Papers we find elms recommended for fences; and the following method of raising them for this purpose is said to be the best. When elm timber is felled in the spring, sow the chips made in trimming or hewing them green, on a piece of ground newly ploughed, as you would corn, and harrow them in. Every chip which has an eye, or bud-knot, or some bark on it, will immediately shoot like the cuttings of potatoes; and the plants thus raised having no tap-roots, but shooting their fibres horizontally in the richest part of the soil, will be more vigorous, and may be more safely and easily transplanted than when raised from seeds, or in any other method. The plants thus raised for elm fences have greatly the advantage of others; as five, six, and sometimes more, stems will arise from the same chip; and such plants, if cut down within three inches of the ground, will multiply their side shoots in proportion, and make a hedge thicker, without running to naked wood, than by any other method yet practised. If kept clipped

ped for three or four years, they will be almost impene- Fences.
trable.

In the second volume of the same work, we meet Observations on quick hedges.
with several observations on quick hedges by a gentle-
man near Bridgewater. He prefers the white and black
thorns to all other plants for this purpose; but is of
opinion, that planting timber trees in them at proper
intervals is a very eligible and proper method. He
raised some of his plants from haws in a nursery;
others he drew up in the woods, or wherever they
could be found. His banks were made flat, and three
feet wide at the top, with a sloping side next the ditches,
which last were dug only two feet below the surface,
and one foot wide at bottom. The turfs were regu-
larly laid, with the grass downwards, on that side of
the ditch on which the hedge was to be raised, and
the best of the mould laid at top. The sets were
straight, long, smooth, and even growing ones plant-
ed as soon as possible after taking up. They were
planted at a foot distance; and about every 40 feet
young fruit-trees, or those of other kinds, such as ash,
oak, elm, beech, as the soil suited them. A second
row of quicksets was then laid on another bed of fresh
earth at the same time, and covered with good mould;
after which the bank was finished and secured properly
from injuries by a dead hedge well wrought together,
and fastened by stakes of oak-trees on the top of the
bank at three feet distance. Wherever any of the
quicksets had failed or were of a dwindling appearance,
he had them replaced with fresh ones from the nursery,
as well as such of the young trees as had been plant-
ed on the top of the bank; and cleared the whole from
weeds.

Fences.

Cyder fruit-trees recommended in hedges.

With regard to the advantage arising from hedges, our author observes, that “if they were of no farther use than as mere fences, it would be the farmer’s interest to keep them up carefully; for the better they are, the more secure are his cattle and crops. But if a judicious mixture of cyder fruit-trees were planted in hedges, the profit arising from them only would abundantly repay the cost of the whole without any loss of ground. It may possibly be objected by some, that the hedges would often be hurt by the boys climbing up to get the fruit; but those who make it should remember, or be told, that the best kinds of cyder-fruit are so hard and austere at the time of their being gathered, that nobody can eat them, and even hogs will hardly touch them. But the greatest benefit, where no fruit-trees are planted, arises from the thorns and wood which quick hedges yield for the fire and other purposes.”

Method of raising hornbeam hedges in Germany.

The author of the Essay on Husbandry recommends the hornbeam plant as one of the best yet known for making fences, according to the method practised in Germany, where such fences are common. “When the German husbandman (says he) erects a fence of this nature, he throws up a parapet of earth, with a ditch on each side, and plants his hornbeam sets in such a manner, that every two plants may be brought to intersect each other in the form of St Andrew’s crosses. In that part where the two plants cross each other, he gently scrapes off the bark, and binds them with straw thwartwise. Here the two plants consolidate in a kind of indissoluble knot, and push from thence horizontal slanting shoots, which form a sort of living palisado or *chevaux de frise*; so that such a protection may be called a

rural fortification. The hedges being pruned annually, and with discretion, will in a few years render the fence impenetrable in every part. Fences.

“ It sometimes happens (says Dr Anderson) that a hedge may have been long neglected, and be in general in a healthy state, but full of gaps and openings, or thin and straggling, as to form but a very imperfect sort of fence. On these occasions, it is in vain to hope to fill up the gaps by planting young quicks; for these would always be outgrown, choked, and starved, by the old plants: nor could it be recovered by cutting clear over by the roots, as the gaps would still continue where they formerly were. The only methods that I know of rendering this a fence are, either to mend up the gaps with deal wood, or to *plash* the hedge; which last operation is always the most eligible where the gaps are not too large to admit of being cured by this means. Dr Anderson's method of mending decayed hedges.

“ The operation I here call *plashing*, may be defined, “ a wattling made of living wood.” To form this, some stems are first selected, to be left as stakes at proper distances, the tops of which are all cut over at the height of four feet from the root. The straggling side-branches of the other part of the hedge are also lopped away. Several of the remaining plants are then cut over, close by the ground, at convenient distances; and the remaining plants are cut perhaps half through, so as to permit them to be bent to one side. They are then bent down almost to a horizontal position, and interwoven with the upright stakes, so as to retain them in that position. Care ought to be taken that these be laid very low at those places where there were formerly gaps; which ought to be farther strengthened

Fences. by some dead stakes or truncheons of willows, which will frequently take root in this case, and continue to live. And sometimes a plant of eglantine will be able to overcome the difficulties it there meets with, strike root, and grow up so as to strengthen the hedge in a most effectual manner.

“ The operator begins at one end of the field, and proceeds regularly forwards, bending all the stems in one direction, so that the points rise above the roots of the others, till the whole wattling is completed to the same height as the uprights.

“ An expert operator will perform this work with much greater expedition than one who has not seen it done could easily imagine. And as all the diagonal wattlings continue to live, and send out shoots from many parts of their stems, and as the upright shoots that rise from the stumps of those plants that have been cut over quickly rush up through the whole hedge, these serve to unite the whole into one entire mass, that forms a strong, durable, and beautiful fence.

“ This is the best method of recovering an old neglected hedge that hath as yet come to my knowledge.

“ In some cases it happens, that the young shoots of a hedge are killed every winter; in which case it soon becomes dead and unsightly, and can never rise to any considerable height. A remedy for this disease may therefore be wished for.

“ Young hedges are observed to be chiefly affected with this disorder; and it is almost always occasioned by an injudicious management of the hedge, by means of which it has been forced to send out too great a number of shoots in summer, that are thus rendered so
small

small and weakly as to be unable to resist the severe weather in winter. Fences. \

“ It often happens, that the owner of a young hedge, with a view to render it very thick and close, cuts it over with the sheers a few inches above the ground the first winter after planting ; in consequence of which, many small shoots spring out from each of the stems that has been cut over :—Each of which, being afterwards cut over in the same manner, sends forth a still greater number of shoots, which are smaller and smaller in proportion to their number.

“ If the soil in which the hedge has been planted is poor, in consequence of this management, the branches, after a few years, become so numerous, that the hedge is unable to send out any shoots at all, and the utmost exertion of the vegetative powers enables it only to put forth leaves. These leaves are renewed in a sickly state for some years, and at last cease to grow at all—the branches become covered with fog, and the hedge perishes entirely.

“ But if the soil be very rich, notwithstanding this great multiplication of the stems, the roots will still have sufficient vigour to force out a great many small shoots, which advance to a great length, but never attain a proportional thickness. And as the vigour of the hedge makes them continue to vegetate very late in autumn, the frosts come on before the tops of these dangling shoots have attained any degree of woody firmness, so that they are killed almost entirely by it ; the whole hedge becomes covered with these long dead shoots, which are always disagreeable to look at, and usually indicate the approaching end of the hedge.

Fences. “ The causes of the disorder being thus explained, it will readily occur, that the only radical cure is amputation ; which, by giving an opportunity to begin with training the hedge anew, gives also an opportunity of avoiding the errors that occasioned it. In this case, care ought to be taken to cut the plants as close to the ground as possible, as there the stems will be less numerous than at any greater height. And particular attention ought to be had to allow very few shoots to arise from the stems that have been cut over, and to guard carefully against shortening them.

“ But as the roots, in the case here supposed, will be very strong, the shoots that are allowed to spring from the stems will be very vigorous, and there will be some danger of their continuing to grow later in the season than they ought in safety to do ; in which case, some part of the top of the shoot may perhaps be killed the first winter, which ought, if possible, to be prevented. This can only be effectually done by giving a check to the vegetation in autumn, so as to allow the young shoots to harden in the points before the winter approaches. If any of the leaves or branches of a tree are cut away while it is in the state of vegetation, the whole plant feels the loss, and it suffers a temporary check in its growth in proportion to the loss that it thus sustains. To check, therefore, the vigorous vegetation at the end of autumn, it will be prudent to choose the beginning of September for the time of lopping off all the supernumerary branches from the young hedge, and for clipping off the side-branches that have sprung out from it ; which will, in general, be sufficient to give it such a check in its growth at that season, as will prevent any of the shoots from advancing afterwards.

afterwards. If the hedge is extremely vigorous, a few buds may be allowed to grow upon the large stumps in the spring, with a view to be cut off at this season, which will tend to stop the vegetation of the hedge still more effectually.

Fences.

“By this mode of management, the hedge may be preserved entire through the first winter. And as the shoots become less vigorous every successive season, there will be less difficulty in preserving them at any future period. It will always be proper, however, to trim the sides of a very vigorous hedge for some years while it is young, about the same season of the year, which will tend powerfully to prevent this malady. But when the hedge has advanced to any considerable height, it will be equally proper to clip it during any of the winter-months, before Candlemas.”

Lord Kaimes, in his work entitled the Gentleman Farmer, gives several directions for the raising and mending of hedges considerably different from those above related. For a deer-park he recommends a wall of stone coped with turf, having laburnums planted close to it. The heads of the plants are to be lopped off, in order to made the branches extend laterally, and interweave in the form of a hedge. The wall will prevent the deer from breaking through; and if the hedge be trained eight feet high, they will not attempt to leap over. He prefers the laburnum plant, because no beast will feed upon it except a hare, and that only when young and the bush tender. Therefore, no extraordinary care is necessary, except to preserve them from the hare for four or five years. A row of alders may be planted in front of the laburnums, which no hare nor any other beast will touch. The wall he re-

Lord Kaimes's observations.

Fence for deer-park.

Fences.

commends to be built in the following manner, as being both cheaper and more durable than one constructed entirely of stone. Raise it of stone to the height of two feet and a half from the ground, after which it is to be coped with sod as follows: First, lay on the wall, with the grassy side under, sod cut with the spade four or five inches deep, and of a length equal to the thickness of the wall. Next, cover this sod with loose earth rounded like a ridge. Third, prepare thin sod, cast with the paring spade, so long as to extend beyond the thickness of the wall, two inches on each side. With these cover the loose earth, keeping the grassy side above; place them so much on the edge, that each sod shall cover part of another, leaving only about two inches without cover: when 20 or 30 yards are thus finished, let the sod be beat with mallets by two men, one on each side of the wall, striking both at the same time. By this operation, the sod becomes a compact body that keeps in the moisture, and encourages the grass to grow. Lastly, Cut off the ragged ends of the sod on each side of the wall, to make the covering neat and regular. The month of October is the proper season for this operation, because the sun and wind, during summer, dry the sod, and hinder the grass from vegetating. Moist soil affords the best sod. Wet soil is commonly too fat for binding; and, at any rate, the watery plants it produces will not thrive in a dry situation. Dry soil, on the other hand, being commonly ill bound with roots, flakes to pieces in handling. The ordinary way of coping with sod, which is to lay them flat and single, looks as if intended to dry the sod and kill the grass; not to mention that

that the foil is liable to be blown off the wall by every ^{Fences.} high wind.

The advantages of a thorn hedge, according to our ^{Advantages of a thorn hedge.} author, are, that it is a very quick grower, when planted in a proper foil; shooting up six or seven feet in a season. Though tender and apt to be hurt by weeds when young, it turns strong, and may be cut into any shape. Even when old, it is more disposed than other trees to lateral shoots; and lastly, its prickles make it the most proper of all for a fence. None of these thorns ought to be planted in a hedge till five years of age, and it is of the utmost importance that they be properly trained in the nursery. The best foil for a nursery, his lordship observes, is between rich and poor. In the latter the plants are dwarfish: in the former, being luxuriant and tender, they are apt to be hurt during the severity of the weather; and these imperfections are incapable of any remedy. An essential requisite in a nursery is free ventilation. "How ^{Of a proper nursery for raising the plants.} common (says his lordship) is it to find nurseries in hollow sheltered places, surrounded with walls and high plantations, more fit for pine-apples than barren trees! The plants thrust out long shoots, but feeble and tender: when exposed in a cold situation, they decay, and sometimes die. But there is a reason for every thing: the nurseryman's view is to make profit by saving ground, and by imposing on the purchaser tall plants, for which he pretends to demand double price. It is so difficult to purchase wholesome and well nursed plants, that every gentleman farmer ought to raise plants for himself.

"As thorns will grow pleasantly from roots, I ^{Of raising them from the roots of old hedges.} have long practised a frugal and expeditious method of raising

Fences.

raising them from the wounded roots that must be cut off when thorns are to be set in a hedge. These roots cut into small parts, and put in a bed of fresh earth, will produce plants the next spring no less vigorous than what are produced from seed; and thus a perpetual succession of plants may be obtained without any more seed. It ought to be a rule, never to admit into a hedge plants under five years old; they deserve all the additional sum that can be demanded for them. Young and feeble plants in a hedge are of slow growth; and, besides the loss of time, the piling necessary to secure them from cattle must be renewed more than once before they become a fence. A thorn hedge may be planted in every month of winter and spring, unless it be frost. But I have always observed, that thorns planted in October are more healthy, push more vigorously, and fewer decay, than at any other time. In preparing the thorns for planting, the roots ought to be left as entire as possible, and nothing cut away but the ragged parts.

Proper method of planting.

“As a thorn hedge suffers greatly by weeds, the ground where they are planted ought to be made perfectly clean. The common method of planting, is to leave eight or nine inches along a side of the intended ditch, termed a *scarfement*; and behind the scarfement to lay the surface soil of the intended ditch, cut into square fods two or three inches deep, its grassy surface under. Upon that fod, whether clean or dirty, the thorns are laid, and the earth of the ditch above them. The grass in the scarfement, with what weeds are in the moved earth, soon grow up, and require double diligence to prevent the young thorns from being choked. The following method deserves all the addition-

al trouble it requires. Leaving a scarfement as above of 10 inches, and also a border for the thorns, broad or narrow according to their size; lay behind the border all the surface of the intended ditch, champed small with the spade, and upon it lay the earth that fell from the spade in cutting the said surface. Cover the scarfement and border with the under earth, three inches thick at least; laying a little more on the border to raise it higher than the scarfement, in order to give room for weeding. After the thorns are prepared by smoothing their ragged roots with a knife, and lopping off their heads to make them grow bushy, they are laid fronting the ditch, with their roots on the border, the head a little higher than the root. Care must be taken to spread the roots among the surface-earth taken out of the ditch, and to cover them with the mouldery earth that lay immediately below. This article is of importance, because the mouldery earth is the finest of all. Cover the stems of the thorns with the next stratum of the ditch, leaving always an inch at the top free. It is no matter how poor this stratum be, as the plants draw no nourishment from it. Go on to finish the ditch, pressing down carefully every row of earth thrown up behind the hedge, which makes a good solid mound impervious to rain. It is a safeguard to the young hedge to raise this mound as perpendicular as possible; and for that reason, it may be proper, in loose soil, when the mound is raised a foot or so, to bind it with a row of tough sod, which will support the earth above till it become solid by lying. In poor soil more care is necessary. Behind the line of the ditch the ground intended for the scarfement and border should be summer-fallowed, manured, and clear-

Fences.

Fences. ed of all grafts roots ; and this culture will make up for the inferiority of the foil. In very poor foils, it is vain to think of planting a thorn hedge. In such ground there is a necessity for a stone fence.

“ The only reason that can be given for laying thorns as above described, is to give the roots space to push in all directions ; even upward into the mound of earth. There may be some advantages in this ; but, in my apprehension, the disadvantage is much greater of heaping so much earth upon the roots as to exclude not only the sun, but the rain which runs down the sloping bank, and has no access to the roots. Instead of laying the thorns fronting the ditch, would it not do better to lay them parallel to it ; covering the roots with three or four inches of the best earth, which would make a hollow between the plants and the sloping bank ? This hollow would intercept every drop of rain that falls on the bank, to sink gradually among the roots. Why, at any rate, should a thorn be put into the ground sloping ? This is not the practice with regard to any other tree ; and I have heard of no experiment to persuade me that a thorn thrives better sloping than erect. There occurs indeed, one objection against planting thorns erect, that the roots have no room to extend themselves on that side where the ditch is. But does it not hold, that when, in their progress, roots meet with a ditch, they do not push onward ; but, changing their direction, push downward at the side of the ditch ? If so, these downward roots will support the ditch, and prevent it from being mouldered down by frost. One thing is evident without experiment, that thorns planted erect may sooner be made a complete fence than when laid sloping as usual. In the

the latter case, the operation is confined to thorns that do not exceed a foot or fifteen inches; but thorns five or six feet high may be planted erect; and a hedge of such thorns, well cultivated in the nursery, will in three years arrive at greater perfection than a hedge managed in the ordinary way will do in twice that time." Fences.

After the hedge is finished, it is absolutely necessary to secure it for some time from the depredations of cattle; and this is by no means an easy matter. "The ordinary method of a paling (says his lordship) is no sufficient defence against cattle: the most gentle make it a rubbing post, and the vicious wantonly break it down with their horns. The only effectual remedy is expensive; viz. two ditches and two hedges, with a mound of earth between them. If this remedy, however, be not palatable, the paling ought, at least, to be of the strongest kind. I recommend the following as the best I am acquainted with: Drive into the ground strong stakes three feet and a half long, with intervals from eight to twelve inches, according to the size of the cattle that are to be enclosed; and all precisely of the same height. Prepare plates of wood sawed out of logs, every plate three inches broad and half an inch thick. Fix them on the head of the stakes with a nail driven down into each. The stakes will be united so firmly, that one cannot be moved without the whole; and will be proof accordingly against the rubbing of cattle. But, after all, it is no fence against vicious cattle. The only proper place for it is the side of a high road, or to fence a plantation of trees. It will indeed be a sufficient fence against sheep, and endure till the hedge itself becomes a fence. A fence thus

Fences. thus completed, including thorns, ditching, wood, nails, &c. will not much exceed two shillings every six yards."

Of training up hedges. His lordship disapproves of the ordinary method of training hedges by cutting off the top and shortening the lateral branches in order to make it thick and bushy. This, as well as the method of cutting off the stems two or three inches above the ground, indeed produces a great number of shoots, and makes a very thick fence, but which becomes so weak when bare of leaves, that cattle break through it in every part. To determine the best method of proceeding in this case, his lordship made an experiment on three hedges, which were twelve years old at the time he wrote. The first was annually pruned at the top and sides; the sides of the second were pruned, but not the top; and the third was allowed to grow without any pruning. The first, at the time of writing, was about four feet broad, and thick from top to bottom; but weak in the stems, and unable to resist any horned beast: the second was strong in its stems, and close from top to bottom: the third was also strong in its stems, but bare of branches for two feet from the ground; the lower ones having been deprived of air and rain by the thick shade of those above them. Hence he directs that hedges should be allowed to grow till the stems be five or six inches in circumference, which will be in ten or twelve years; at which time the hedge will be fifteen feet or more in height. The lateral branches next the ground must be pruned within two feet of the stem; those above must be made shorter and shorter in proportion to their distance from the ground; and at five feet high they must be cut close to the stem, leaving

ing all above full freedom of growth. By this dressing the hedge takes on the appearance of a very steep roof; and it ought to be kept in that form by pruning. This form gives free access to rain, sun, and air: every twig has its share, and the whole is preserved in vigour. When the stems have arrived at their proper bulk, cut them over at five feet from the ground, where the lateral branches end. This answers two excellent purposes: the first is to strengthen the hedge, the sap that formerly ascended to the top being now distributed to the branches; the next is, that a tall hedge stagnates the air, and poisons both corn and grass near it. A hedge trained in this manner is impenetrable even by a bull.

Fences.

With regard to the practice of *plashing* an old hedge recommended by Dr Anderson, his lordship observes, that "it makes a good interim fence, but, at the long run, is destructive to the plants; and accordingly there is scarcely to be met with a complete good hedge where plashing has been long practised. A thorn is a tree of long life. If, instead of being massacred by plashing, it were raised and dressed in the way here described, it would continue a firm hedge perhaps 500 years."

Plashing of hedges disapproved of.

In the fourth volume of Mr Young's Northern Tour,* the author recommends the transplanting of old hedges, which his correspondent Mr Beverly says he has tried with prodigious success.

Mr Bakewell, we are told, is very curious in his fences, and plants his quicks in a different manner from what

Mr Bakewell's fences.

Fences.

what is common in various parts of the kingdom. He plants one row at a foot from set to set, and making his ditch, lays the earth which comes out of it to form a bank on the side opposite to the quick. In the common method, the bank is made on the quick side above it. Reasons are not wanting to induce a preference of this method. The plants grow only in the surface earth uncovered from the atmosphere, which must necessarily be a great advantage; whereas, in the usual way of planting, that earth, which is always the best, is loaded by a thick covering obliquely of the earth out of the ditch. If the roots shoot in the best soil, they will be out of the reach of the influences of the air; the consequence of which is, that they cannot have so large a space of that earth as if set on the flat. The way to have a tree or a quick thrive in the best manner possible, is to set it on the surface without any ditch or trench, that cuts off half its pasture. But if a ditch is necessary, the next best way must of course be still to keep it on the flat surface; and the worst way to cover up that surface, by loading it with the dead earth out of a trench. To say that there are good hedges in the common method is not a conclusive argument, unless both were tried on the same soil and exposure.

Of hedges
in stony
and gravelly
soils.

In the 7th volume of the same work, a correspondent, who signs himself M. M. observes, that notwithstanding all the improvements that have been made in the construction of hedges and fences, there are many soils in England, which, from their sandy and gravelly natures, are little adapted to any of the plants in common use, and are therefore subject to all the inconveniences of dead hedges and gaps. Of this kind
are.

are all the sandy and gravelly enclosures, which constitute so large a part of many districts in the island. Fences.
 For these our author recommends a triple row of furze; though, notwithstanding its advantages, he says it is liable to be destroyed by severe winters, contrary to the assertion of Lord Kaimes above related. "It is liable (says he) to be so completely cut off by a severe winter, that I have seen tracts of many hundred acres laid open in the space of a few weeks, and reduced to as defenceless a state as the surrounding wastes. On such soils therefore he recommends the holly; the only disadvantage of which, he says, is its slow growth. On most of these soils also the black thorn will rise spontaneously; and even the quick, though slowly, will advance to a sufficient degree of perfection. The birch, however, he particularly recommends, as growing equally on the driest and on the wettest soils, propagating itself in such numbers, that, were they not destroyed, all the sandy wastes of this kingdom would be quickly covered with them. He recommends particularly the keeping of a nursery for such plants as are commonly used for hedges. "I generally (says he) pick out a bit of barren land, and after ploughing it three or four times to bury and destroy the heath, I find it answer extremely well for a nursery. Into this spot I transplant quick, hollies, and every tree which I use for fences or plantations. By establishing such a nursery, a gentleman will always be able to command a sufficiency of strong and hardy plants which will not deceive his expectations. I look upon thorns of five or six years old, which have been twice transplanted from the seed-bed, to be the best of all; but as it may be necessary to fill up casual gaps
 in

Of a proper
nursery.

Fences. in hedges that have been planted several years, a provision should be made of plants of every age, to twelve or fourteen years old. All plants which are intended to be moved, should be transplanted every two, or at most three years; without this attention, they attach themselves so firmly to the soil as renders a subsequent operation dangerous. All who transplant quicks or hollies ought to begin their labours as early as convenient in the autumn; for I have found, by repeated experience, that neither of these plants succeeds so well in the spring."

Of repairing ruinous hedges.

Where the fences of a tract of ground are in a very ruinous condition, it is absolutely necessary to scour the ditches, throw up the banks, and secure the whole immediately by the firmest dead fences we can procure. If there is a total want of living plants, the cultivator can do nothing but plant new hedges; but if, as is generally the case, the banks are furnished with a multitude of old stems, though totally unconnected as a fence, the time and labour requisite for the intended improvement will be considerably abridged. All the straggling branches, which add no solidity to the fence, are to be cut off; after which the rest of the stems must be shortened to the height of three or four feet. The method of cutting down every thing to the ground, which is now so general, our author highly condemns. "Such a fence (says he) has within it no principle of strength and connection; it is equally exposed in every part to depredations of cattle and sportsmen; and even should it escape these, the first fall of snow will nearly demolish it. On the contrary, wherever these vegetable palisades can be left, they are impenetrable either for man

or

or horse, and form so many points of union which support the rest." Fences.

Another method of strengthening defective fences is, to bend down some of the lateral shoots in a horizontal direction, and to spread them along the line of the farm, like espalier trees in a garden. A single stem, when it rises perpendicularly, will not secure a space of more than two or three feet, but when bent longitudinally, it will form a barrier at least sufficient to repel all cattle but hogs for twelve or fourteen on one side. By bending down, our author does not mean the common *plashing* method, which is very injurious to the plants; but the spreading two or three of the most convenient branches along the hedge, and fastening them down either by pegs or tying, without injury to the stem, until they habitually take the proposed direction. Those who make the experiment for the first time will be astonished how small a number of plants may be made to fill a bank, with only trifling intervals. The birch is particularly useful for this purpose; being of so flexible a nature, that shoots of ten or twelve feet in length may be easily forced into a horizontal direction; and if the other shoots are pruned away, all the juices of the plant will be applied to nourish the selected few: by which means they will in a few years acquire all the advantages of posts and rails, with this material difference, that instead of decaying, they become annually better. It is besides the property of all inclined branches to send up a multitude of perpendicular shoots; so that by this horizontal inclination, if judiciously made, you may acquire almost all the advantages of the thickest fence; but when the stems are too old and brittle to bear this operation,

Plashing of
hedges dis-
approved.

Fences.

operation, it will be adviseable to cut off all the useles ones close to the ground, and next spring they will be succeeded by a number of young and vigorous ones. Select the best of these to be trained in the manner already directed, and extirpate all the rest, to increase their vigour. The shoots of such old stems as have been just now described will attain a greater size in three or four years than any young ones that can be planted will do in twelve.

In what case the cutting down of hedges is proper.

It frequently happens, says the same writer, that the fences of a estate have been neglected for many years, and exhibit nothing but ragged and deformed stems at great intervals. In this case, it will be proper to cut them all off level with the ground: the consequence of this is, that next year they will put forth a great number of shoots, which may be laid down in every direction, and trained for the improvement of the fence. When this operation is performed, however, it ought always to be done, with an axe, and not with a saw; it being found that the latter instrument generally prevents the vegetation of the plant. All the shoots laid down in this manner should be allowed to remain for several years, that they may be firmly rooted. Thus they will make prodigious advances; and it is to be observed, that the more the parent plant is divested of all superfluous branches, the greater will be the nourishment transmitted to the scions.

Our author, however, is inclined to suspect that the most perfect form of a hedge, at least in all but those composed of thorns and prickly plants, is to train up as many stems as will nearly touch each other. The force of every fence consists chiefly in the upright stems: where these are sufficiently near and
strong,

strong, the hedge resists all opposition, and will equally repel the violence of the bull, and the insidious attacks of the hogs. It is absolutely proper that all hedges should be inspected once a-year; when not only the ditch ought to be thrown out, and the bank supported, but the straggling shoots of all the live plants ought to be pruned. By these are meant all such as project over the ditch beyond the line of the hedge, and which add nothing to its strength, though they deprive the useful stems of part of their nourishment. Where a hedge is composed of plants of inferior value, it will be proper to train those in the manner just now recommended, and to plant the bank with quick or holly. When these last have attained a sufficient size, the others may be extirpated; which is best done by cutting down all the shoots repeatedly in the summer, and leaving the roots to rot in the hedge.

In the 13th volume of the Annals of Agriculture, Mr Erskine, Esq. gives an account of a method of fencing very much resembling that recommended by Lord Kaimes. That gentleman is of opinion, that, in some cases *dead stone walls*, as they are called, are more advantageous than hedges. "That hedges (says he) are more ornamental, cannot be denied; and they are generally allowed to afford more shelter; but the length of time, the constant attention, and continual expence of defending them until they bear even the resemblance of a fence, induces many people in those places where the materials are easily procured, to prefer the dry stone walls; for though the first cost is considerable, yet as the farmer reaps the immediate benefit of the fence (which is undoubtedly

Fences.

Erskine's method of constructing hedges.

Fences. the most secure one), they are thought on the whole to be the least expensive ; besides, the cattle in exposed situations, and especially in these northern parts, are so impatient of confinement at the commencement of the long, cold, wet nights, that no hedges I have ever yet seen, in any part of this island, are sufficient to keep them in."

From considerations of this kind, the late Sir George Suttie of East Lothian was induced to think of a fence which might join the strength of the wall to the ornament of the hedge. His thorns were planted in the usual manner on the side of the ditch : but instead of putting behind them a post and rail or paling on the top of the bank, he erected a wall two feet and a half high ; and being well situated for procuring lime, he used it in the construction of these walls which Mr Erskine greatly recommends ; "as the satisfaction they afford, by requiring no repairs, and the duration of them, more than repay the expence : but, where the price of lime is high, they may be built without any cement, and answer the purpose very well, if the work is properly executed."

In making a new fence of this kind, the surface of the ground should be pared off the breadth of the ditch, and likewise for two feet more, in order to prevent as much as possible the thorns from being injured by the growth of grass and weeds. The ditch should be five feet broad, two and a half in depth, and one foot broad at the bottom. Leave one foot for an edging or scarfment, then dig the earth one spit of a spade for about one foot, and put about three inches of good earth below the thorn, which should be laid nearly horizontal, but the point rather inclining upwards,

wards, in order to let the rain drip to the roots; then add a foot of good earth above it: leave three or four inches of a scarfement before another thorn is planted; it must not be directly over the lower one, but about nine inches or a foot to one side of it: then throw a foot of good earth on the thorn, and trample it well down, and level the top of the bank for about three feet and a half for the base of the wall to rest on. This base should be about nine or ten inches, but must not exceed one foot from the thorn. The wall ought to be about two feet thick at the bottom and one foot at the top: the cope to be a single stone laid flat; then covered with two fods of turf, the grafs of the undermost to be next the wall, and the other fod must have the grafs side uppermost. The fods should be of some thickness, in order to retain moisture; so that they may adhere together, and not be easily displaced by the wind. The height of the wall to be two feet and a half, exclusive of the fods; which together should be from four to six inches, by which means the wall would be near to three feet altogether. The expence of the fences cannot so easily be counted, on account of the difference of the prices of labour in different parts. Mr Erskine had them done with lime, every thing included, from 10½ to 13d. per ell (which is equal to 37 inches 2 parts), according to the ease or difficulty of working the quarry, and the distance of it from the place where the fence is erected. The lime costs about 6d. per boll of about 4.0872667 bushels; and from 15 to 16 bolls of lime are used to the rood of 36 square ells Scots measure; and there are upwards of 43 Scots ells, or 44 English yards. When the common round or flint stones are made use of, as they require more lime, it is

Fences.

Fences.

necessary to use 30 or 35 bolls of lime to the rood. The thorns are sold from five to ten shillings per thousand, according to their age, reckoning six score to the hundred. Making the ditch, laying the thorns, and preparing the top of the wall, generally cost from 7d. to 8d. every six ells. About 50 carts of stones, each cart carrying from seven to nine cwt. will build a rood; the carriage at 2d. per cart for half a mile's distance.

Warmth is undoubtedly extremely beneficial to hedges; and the walls give an effectual shelter, which, in exposed situations is absolutely necessary for rearing young hedges; and they likewise preserve a proper degree of moisture about the roots. If the hedges have been planted for six or seven years before the wall is built, cut them over to two or three inches above the ground with a sharp tool, either in October or November, or early in the spring; and erect the wall as quickly in that season as possible (the spring in this country can scarcely be said to begin till the end of March. It is almost impossible to imagine the rapidity with which hedges grow in favourable situations. Mr Erskine had one cut over in the spring, and by the end of the year it was almost as high as the wall. In three years he supposed, that not even the Highland sheep, who easily overleap a wall of four feet and a half in height, would have been able to break through it.

Notwithstanding the reasons that have been given already against the planting of timber trees in hedges, we find the practice recommended by some authors as one of the best situations for raising ship-timber. The reasons are, that the roots have free range in the adjoining enclosures, and the top is exposed to the exercise

Reasons for
planting
oak trees in
hedges.

Fences.

ercise of the winds; by which means the trees are at once enabled to throw out strong arms, and have a large spreading head at the same time; so that we thus at once obtain quickness of growth with strength and crookedness of timber. Well trained timber trees, it is alleged, are not prejudicial to hedges, though pollards and low spreading trees are destructive to the hedge-wood which grows under them; neither are high trees prejudicial to corn fields like high hedges and pollards, which prevent a proper circulation of air; and in Norfolk, where the cultivation of grain is carried on in great perfection, such lands are said to be *wood-bound*. But when a hedge is trimmed down to four or five feet high, with oaks interspersed, a circulation of air is rather promoted than retarded by it: and a trimmed hedge will thrive quite well under tall-stemmed trees, particularly oaks. For arable enclosures, therefore, hedges are recommended of four or five feet high, with oak-timbers from 15 to 25 feet stem. Higher hedges are more eligible for grass-lands: the grasses affect warmth, by which their growth is promoted, and consequently their quantity is increased, though, perhaps, their quality may suffer some injury. Upon bleak hills, and in exposed situations, it will be proper to have two or even three rows of hedge-wood, about four feet distant from each other; the middle row being permitted to reach, and always to remain, at its natural height: whilst the side rows are cut down alternately to give perpetual security to the bottom, and afford a constant supply of materials for dead hedges and other purposes of underwood.

“Whins (furze) have been often employed, says Dr Anderson, as a fence when sown upon the top of a ^{Hedges of whins or furze,}

Fences. bank. They are attended with the convenience of coming very quickly to their perfection, and of growing upon a soil on which few other plants could be made to thrive; but in the way that they are commonly employed, they are neither a strong nor a lasting fence. The first of these defects may, in some measure, be removed, by making the bank upon which they are sowed (for they never should be transplanted) of a considerable breadth; in order that the largeness of the aggregate body, considered as one mass, may, in some measure, make up for the want of strength in each individual plant. With this view, a bank may be raised of five or six feet in breadth at the top, with a large ditch on each side of it; raising the bank as high as the earth taken from the ditches will permit; the surface of which should be sowed pretty thick with whin seeds. These will come up very quickly; and, in two or three years, will form a barrier that few animals will attempt to break through, and will continue in that state of perfection for some years. But the greatest objection to this plant as a fence, is that, as it advances in size, the old prickles always die away; there being never more of these alive at any time upon the plant, than those that have been the produce of the year immediately preceding; and these thus gradually falling away, leave the stems naked below as they advance in height; so that it very soon becomes an exceeding poor and unsightly fence; the stems being entirely bare, and so slender withal as not to be able to make a sufficient resistance to almost any animal whatever. To remedy this great defect, either of the two following methods may be adopted. The first is to take care to keep the bank always stored with young plants;

plants; never allowing them to grow to such a height as to become bare below: and it was principally to admit of this, without losing at any time the use of the fence, that I have advised the bank to be made of such an unusual breadth. For if one side of the hedge be cut quite close to the bank, when it is only two or three years old, the other half will remain as a fence till that side become strong again; and then the opposite side may be cut down in its turn; and so on alternately as long as you may incline: by which means the bank will always have a strong hedge upon it without ever becoming naked at the root. And, as this plant, when ~~brushed~~, is one of the most valuable kinds of winter food yet known for all kinds of domestic animals; the young tops may be carried home and employed for that purpose by the farmer; which will abundantly compensate for the trouble of cutting, and the waste of ground that is occasioned by the breadth of the bank.

“ The other method of preserving a hedge of whins from turning open below, can only be practised where sheep are kept; but may be there employed with great propriety. In this case it will be proper to sow the seeds upon a conical bank of earth, shoved up from the surface of the ground on each side without any ditches. If this is preserved from the sheep for two or three years at first, they may then be allowed free access to it; and, as they can get up close to the foot of the bank upon each side, if they have been accustomed to this kind of food, they will eat up all the young shoots that are within their reach, which will occasion them to send out a great many lateral shoots: and these being continually browsed upon, soon become as close as could

Fences. be desired, and are then in no sort of danger of becoming naked at the root, although the middle part should advance to a considerable height.

Where furze or whins are to be used either as a fence by themselves, or in assistance to another, it is perhaps more proper to use the French seed than that produced in Great Britain, as the former seldom ripens in this country, and consequently cannot, like the latter, overrun the adjacent enclosures. It may be had at the seed-shops in London, and one pound will sow 40 statute roods. When used as an assistant to a hedge, it is more proper to sow it on the back of the bank than on the top of it; as in this case it is more apt to overhang the young plants in the face of the bank; whilst in the other it is better situated for guarding the bank, and preventing it from being torn down by cattle. The method of sowing is as follows: Chop a drill with a sharp spade about two-thirds of the way up the back of the bank, making the cleft gape as wide as may be without breaking off the lip; and having the seed in a quart bottle, stopped with a cork and goose quill, or with a perforated wooden stopper, trickle it along the drill, covering it by means of a broom drawn gently above and over the mouth of the drill. Closing the drill with the back of the spade, shuts up the the seeds too much from the air, and thus keeps them too long from rising.

**Gooseberry
hedge.**

We do not know that any person has yet attempted to make use of the gooseberry for the purpose of making hedges, though few plants seem better adapted for that purpose. It grows readily. Some varieties of it rise to a considerable height, and by the strength and pumber of its prickles, it would effectually prevent
any

any animal from breaking through. It is said, that ^{Fences.} some species of the mulberry not only grow and thrive in England, but are capable of being reared to perfection in Scotland, as has been experienced at Dalkeith. As the leaves of this plant are the food of the silk-worm, which produces the most beautiful and valuable of all the materials that can occupy the loom, it is perhaps worthy of attention how far it might be worth while to rear it as a fence in hedge-rows, with a view to its becoming the basis of a valuable manufacture.

— Dry stone walls are sometimes erected of those round ^{Fences of;} and apparently water-worn stones which the plough ^{dry stone} throws ^{walis.} out, and which may be gathered in every field. They are usually coped with sod. This, however, is a very indifferent fence. In most instances it is erected by common labourers, and is therefore ill constructed, as not even to be of an uniform thickness from top to bottom. The round figure of the stones also prevents the building from being well bound together. Even the cattle rubbing themselves against it are apt to make considerable gaps, which render constant attention necessary to keep it in repair. It is cheaply executed, however, and affords the means of at once fencing the land and clearing it of stones. When dry stone walls are skilfully built by masons, and made with quarried stones finished with a good coping, they look well, and last for many years; but the coping ought to be of stone, and not of turf or mud.

To render stone and lime walls valuable as fences, they should have a broad base, and have a foundation sufficiently deep to prevent their being injured by the loosening

Fences.

loofening of the soil which is produced by frost. This fence is very durable, but it is also very expensive. To be in perfection, it ought to be executed not with common stones gathered from the fields, but with stones from the quarry : It ought to be secured at the top with a coping of stone of the flag-kind laid together in such a way as to render the wall narrow at the top like the roof of a house. If the coping is neglected, the moisture soon finds its way into the heart of the wall, and it is also liable to various accidents from idle persons climbing over it.

The Galloway dike.

The Galloway dike owes its name to the county in which it was first used. It consists of a broad building of dry stones tapering upwards. Large flat stones are then laid on like a coping, and project over the wall on each side. Above those stones large rugged round stones are laid, and smaller stones above these, so as to admit a free passage to the winds which whistle through them. The Galloway dike is never raised very high, but its tottering appearance so terrifies the cattle and sheep, that they dare not touch it ; so that it is a very effectual fence, though it neither affords shelter nor ornament to the country. It has the advantage, however, of being erected at a very trifling expence ; it is not unsuitable to those lower parts of the country in which the shelter of high trees and hedges would prove pernicious to the corn crop, and where the confinement of the stock is all that is required.

Clay is sometimes used instead of lime for binding stone walls ; but it is a very defective cement ; for if frost suddenly succeed to wet weather it is apt to swell and to tumble down at the next thaw. To guard against the effects of moisture, these stone and clay walls

walls are sometimes rough-cast or coated over with lime. If the coating is very thick and the wall properly coped, it may last in this way as long as a wall of stone and lime. Fences.

For the sake of the appearance, dry-stone walls have sometimes two or three inches at the top of them on each side lipped or washed with lime, which adds nothing to their strength, but gives them the appearance of being built entirely with stone and lime. With the same view, and with the same effect, they are sometimes also broad-cast or coated with lime over their whole surface. Dry-stone walls, after they are finished, are sometimes prised and harled, or rough-cast, that is, the mason fills up all the interstices of the building with small stones, and afterwards coats it over with lime, which adds considerably to its durability.

Low dry-stone walls have sometimes a light paling at the top, which gives them a handsome appearance.

Brick walls are sometimes used where stones are extremely scarce, but they are chiefly employed for facing garden walls.

Frame walls are constructed in the following manner. A frame of boards of the width and height intended for the future wall is placed upon the line that has been dug for a foundation. The frame is filled to the top with stones gathered from the adjoining fields, and a quantity of liquid mortar is poured in amongst them sufficient to fill up every interstice. The whole is allowed to remain for a day or two, or longer, till the building is dried so far as to have acquired some stability. The frame is then removed, and placed a little farther on the same line, but in contact with the last-made piece of wall, and the operation is renewed. Frame walls.

This

Fences. This is supposed to have been a very ancient mode of building.

Turf walls are found very useful in upland districts for temporary purposes, such as for folds, or for protecting young plantations or young hedges. Their strength is sometimes increased, without augmenting the expence of the construction, by intermingling them with stones, that is, by forming the wall of alternate layers of turf and stone.

Mud walls. Mud walls, with a mixture of straw, are very frequent in many places both of England and Scotland, and they are used not only for fences, but also for constructing the walls of farm houses and offices, in the poorer parts of the country. They are formed in the following manner. Straw and clay are incorporated with each other, like hair with plaister lime, and formed into large pieces. A stratum of these is laid at the bottom of the intended wall. The different pieces are then firmly kneaded with the hand, and pressed at each side with a flat board, which not only consolidates, but gives smoothness and uniformity to the work. Successive strata are added till the wall is reared to its intended height. If walls thus constructed are properly coated with lime, to protect them against moisture, they become very durable; and their appearance is not inferior to that of a stone and lime building.

Compound fences.

Of compound fences, the most ordinary is the single hedge and ditch, with or without paling. The mode of planting these hedges has been already stated on the authority of Lord Kaimes and others; and we shall only add, that if a hedge is wished to rise with rapidity, the spot in which it is planted ought to be enriched with lime, compost, or other manures, as hedge plants cannot, any

any more than other plants, spring rapidly without cultivation. Where a hedge is planted at the top of a ditch, it may also be remarked, that it is doubly necessary to give the ditch a proper degree of slope, that it may not be undermined by any accident, which would have the effect to lay bare the roots of the hedge, or entirely to bring it down. Where it is wished to render lands enclosed with hedge and ditch cheaply fencible at once, a kind of Galloway dike, consisting of some rows of large coarse loose stones, may be placed upon the top of the bank, which will have the effect of protecting the hedge against cattle.

The double ditch, with a hedge in the front of each, is now practised, particularly on cold lands, in many parts of Great Britain. It may be remarked, that where these double ditches are wanted for drains, it is undoubtedly a proper practice; but, in other situations, it is exceptionable, as laying out unprofitably a large portion of the soil.

When a hedge and ditch is used, whether single or double, the hedge is sometimes placed not at the bottom of the bank, which is the usual way, but in the middle of it, at some height above the ordinary surface of the field. In such a mode of planting, the hedge is exposed to great injury from the bank mouldering down, and from want of proper nourishment; but the practice is sometimes necessary upon wet lands, where hedges would not thrive, if placed upon the common surface. Sometimes the face of a natural declivity is cut down, in a sloping direction, to within 18 or 20 inches of the bottom. Here a bed is made and covered with good earth, in which the plants are inserted. A hedge planted in this way looks formidable, from the side facing the

Fences. the bank ; but it is exposed to more accidents, from a failure of its soil in consequence of frosts, than if planted at the bottom of the bank.

Hedge and bank fence. Sometimes what is called a hedge and bank, or hedge on the top of a bank, is made use of. It consists of a bank of earth taken from the adjoining grounds, broad at bottom and tapering towards the top, along the summit of which the hedge is planted. Such hedges are extremely liable to decay, in consequence of the artificial mound on which they stand, being unable to retain sufficient moisture for their support, or being washed away from about their roots.

Devonshire fence. The Devonshire fence resembles the one now described. It consists of an earthen mound seven feet wide at bottom, and four feet at the top, and five in height. In the middle of the top of it a row of quicks is planted ; and on each side at two feet distance a row of willow stakes, of about an inch in diameter each, and from eighteen inches to two feet in length, is stuck in sloping a little outwards. These stakes take root, and form a kind of live fence for the preservation of the quicks in the middle.

Palings are frequently employed for the protection of young hedges, whether planted on the plain soil or on the top of a ditch : dead hedges, of the kinds formerly mentioned, are also employed for the same purpose. The dead hedge is preferable to the paling, as it shelters the young plants from the inclemency of the weather. The dead hedge, however, ought always to be at some distance from the living one, to allow the latter freely to put forth its branches. As already noticed, walls of different kinds are sometimes erected, whether Galloway dikes or of stone and lime,

for the protection of young hedges; but there is a ^{Fences.} mode of making a hedge in the middle or in the face ^{Hedge in the face of a wall.} of a wall which deserves attention. It is executed in the following manner: The face of the bank is first cut down not quite perpendicular, but nearly so. A facing of stone is then begun at the bottom, and carried up regularly in the manner that stone walls are generally built. When it is raised about eighteen inches or two feet high, according to circumstances, the space between the wall and the bank is filled up with good earth, well broke and mixed with lime or compost. The thorns are laid upon this earth in such a manner, as that at least four inches of the root and stem shall rest upon the earth, and the extremity of the top shall project beyond the wall. When the plants are thus regularly laid, the roots are covered with earth, and the wall continued upwards, a hole having been left which each plant peeps through. As the wall advances upwards, the space between it and the bank is gradually filled up; when completed the wall is finished with a coping of sod or of stone and lime. When the plants begin to vegetate, the young shoots appear in the face of the wall, rising in a perpendicular direction. It is said, that Sir James Hall of Dunglass has adopted this mode of enclosing to a considerable extent in East Lothian; that the hedges have made great progress; and that they exhibit, upon the whole, an extremely handsome appearance.

Whatever may be thought of the propriety of plant- ^{Belts of planting} ing trees in hedge-rows, there can be no doubt that in certain situations the addition to a hedge, or hedge and ditch, of a belt of planting is a valuable acquisition to its owner and to the country. It is certain, however,

as

Fences. as formerly stated, that in low rich soils where corn is chiefly cultivated, particularly when surrounded by hills, belts of planting are not only unnecessary, but even hurtful to the crop. But there are other situations in which they are of the highest value. The peninsula, which forms the county of Caithness, is said to be a proof of this. Its soil is of a good quality, but its value is greatly impaired by its being exposed to sea-winds, whose severity checks all vegetation. Many tracts throughout the island are nearly in the same situation; and in all of them nothing more is wanted to improve the country than to intersect it in a judicious manner with hedges and belts of planting. Where belts of planting are meant to remain as an efficient fence, they ought to be of a considerable breadth. In poor and cold situations the breadth ought to be such as to allow space for planting a great number of trees, which, from the shelter they mutually afford, may protect each others growth against the severity of the climate. With the same view, in cold and exposed situations, the young trees should be planted very thick; perhaps four or five times the number that can grow to a full size should be planted. This practice affords a choice of the most healthy plants to be left when the plantation is thinned. In belts of planting an error is sometimes committed of mingling firs, larches, and pines, with oaks, ashes, &c. with the intention that the evergreens should protect for a certain time the other trees and thereafter be removed. The effect of which too frequently is, that when the evergreens are taken away, their growth is not only checked for several years; but being unable, after experiencing so much shelter, to resist the severity of the climate, they die altogether.

ther. This is the more likely to happen in consequence of the rapidity with which the firs and larches grow; for the oaks and other trees are drawn up along with them, and acquire, in some measure, the nature of hot-house plants, unfit to encounter the blasts of a northern climate: hence belts of planting should either be made altogether of evergreens, or altogether of deciduous plants, such as oak, ash, &c. If the evergreens are at all introduced among these last, it ought to be sparingly, and at the outside of the belt, with the view to afford only a moderate degree of shelter.

Fences.

Where fields are meant to remain constantly in pasture, the belts may be made in a serpentine, and sometimes in a circular form, both for the sake of ornament, and to afford more complete shelter; but this cannot be done where the plough is meant to be introduced. Upon a north exposure, the belts should cross each other at proper distances, to afford more complete shelter. Upon a south exposure, they ought to run from south to north, to afford a defence against the east and west winds, which are the strongest in this country. Belts of planting require themselves to be fenced. A fence, which is merely intended to protect their growth, may consist of a mud wall; but if a permanent security is wanted, a hedge and ditch will be necessary.

In some situations, instead of the belt of planting, it is customary to plant only the corners of the fields; and this plan is advisable, where the country requires but a moderate degree of shelter, added to that which it may derive from thriving hedges.

It has been proposed, that on all sheep farms of any

Fences.

extent, there ought to be one or more circular belts of planting, enclosing a space of about an acre or an acre and a half in the centre, with a serpentine road leading through the belt into this enclosure, the use of which is evident. In heavy falls of snow numerous flocks are sometimes buried, and the lives of the shepherds are not unfrequently lost in attempting to drive them to a place of safety. On such occasions, the enclosures we have now mentioned would be of the utmost value. When a storm threatened, the sheep might be driven to these enclosures, where the snow could never be piled up by driving winds; and they might there be fed and remain with entire safety. If due care were taken to litter the place, a quantity of valuable dung might be collected, if the storm should remain for any length of time.

The reed fence.

The reed fence has hitherto been only used in gardens. It consists of a kind of wall, formed by sewing with wrought yarn bundles of reeds, applied perpendicularly to a railing. This fence seems well adapted for giving temporary shelter to cattle, but as the materials of it cannot be everywhere found, its use must be very limited.

Gate-posts.

The entry to every enclosure ought to be secured by gate-posts; which, if circumstances will permit, ought always to be of stone, and, if possible, of hewn stone, as these, when properly constructed, will never fail. Trees are sometimes planted for this purpose, and, when they have acquired a certain size, they are cut over about ten feet above the surface of the ground. These form the most durable of all gate-posts. They sometimes, however, misgive; in which case it is difficult to repair the defect. When gate-posts are made
of

of dead timber, they should be strong, and the wood well prepared by a coat of oil paint, as already mentioned. Fences.

Of gates for enclosures there are different kinds. Gates.
 What is called the *swing-gate* that crosses the whole breadth of a carriage road, and is of one piece, is by no means an advisable form. The length of its bars renders it expensive, and its great weight with which it pulls against the gate-post, overstrains its own hinges, and is apt to bring down the side of the gate, unless it is erected in a very costly and solid manner. For this reason, a gate with two folding doors is preferable: it hangs upon the gate-post only with half its weight, in consequence of its being divided into two parts. Its hinges are not so liable to be hurt by straining, nor are its joints so liable to be broke. What is called the *slip-bar gate*, consisting of three separate bars which are taken out, and put into the gate-posts every time the entry to the fields is opened and shut, is the best kind of gate, so far as cheapness and durability are concerned; but it does not admit of being locked, which renders it unfit for use near a publick road, and the opening and shutting of it are also attended with a considerable degree of trouble.

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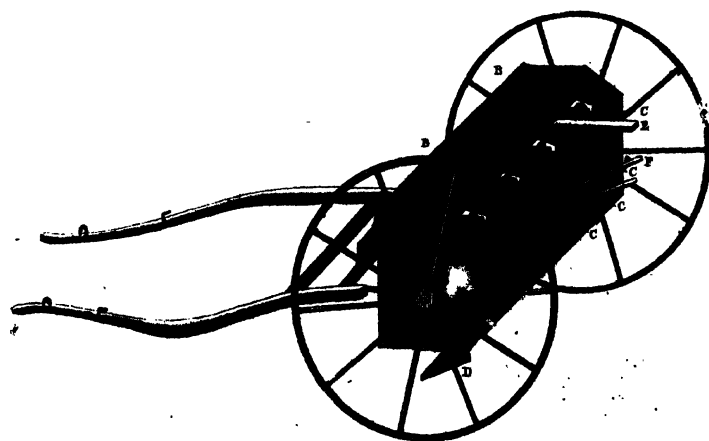
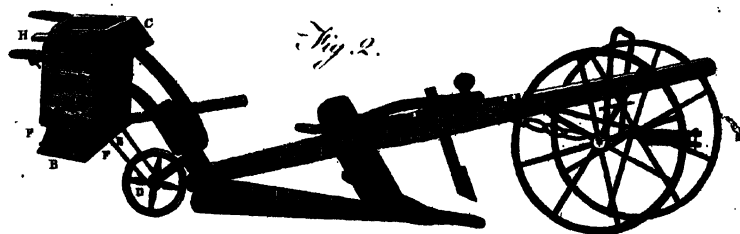
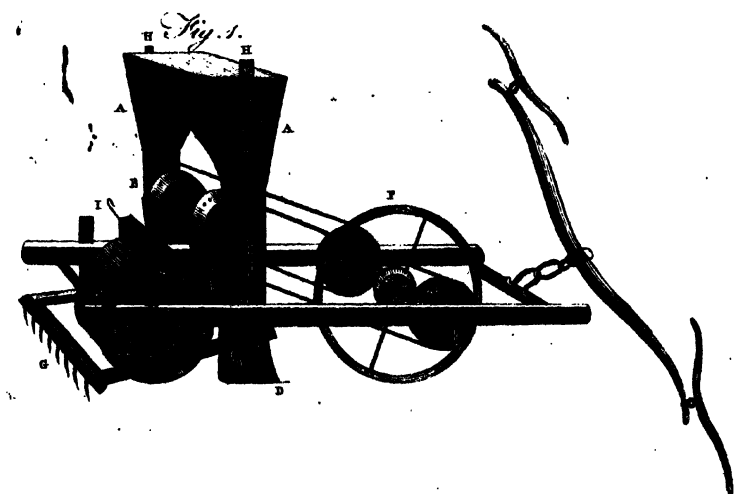


Fig. 1.

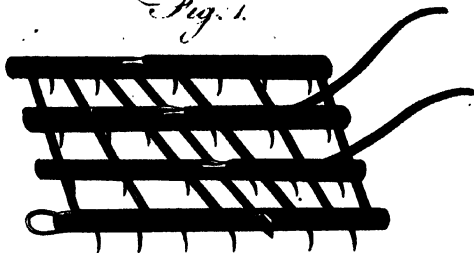


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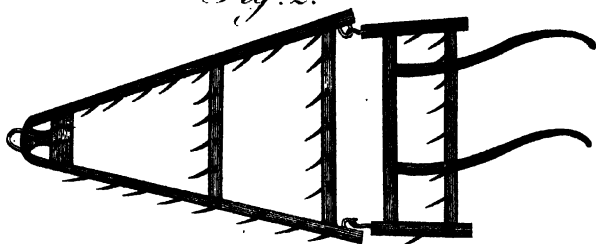


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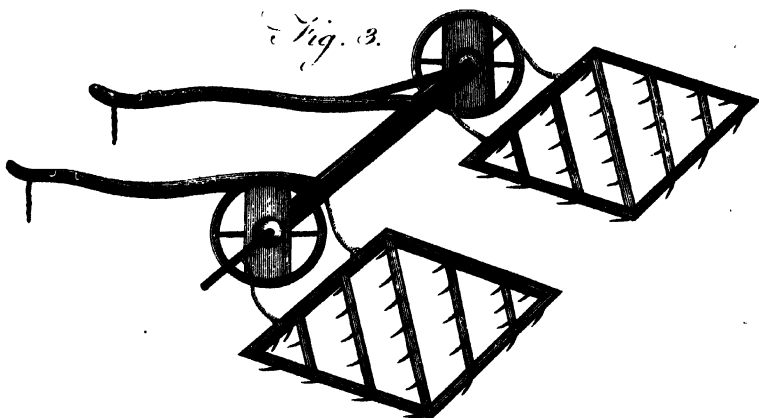
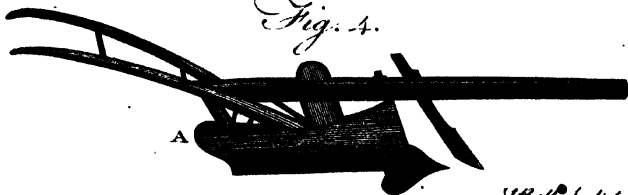
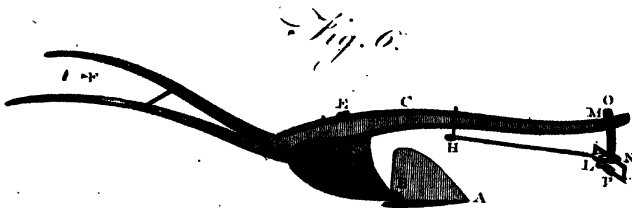
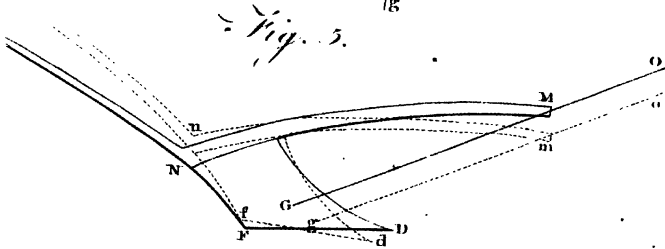
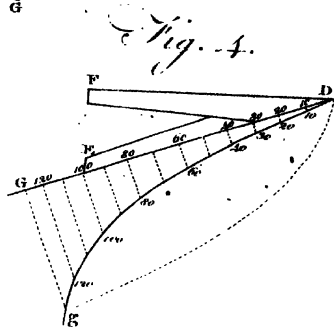
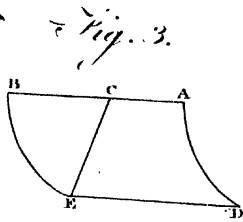
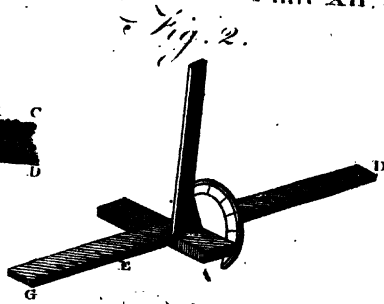
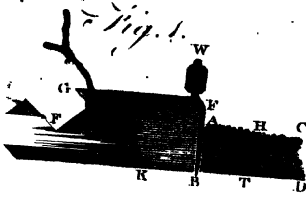


Fig. 4.



Sh. Bell Sculpt.



Albion, 1841.

Fig. 1.

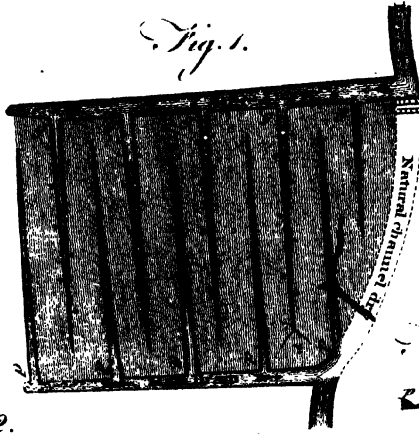


Fig. 2.



Fig. 3.



Fig. 4.

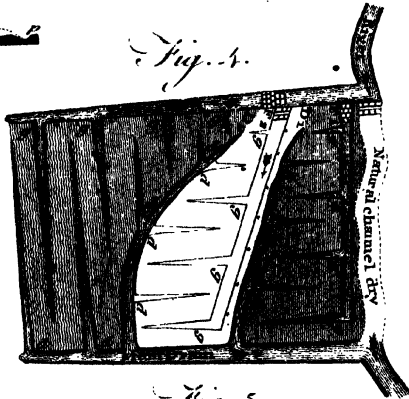
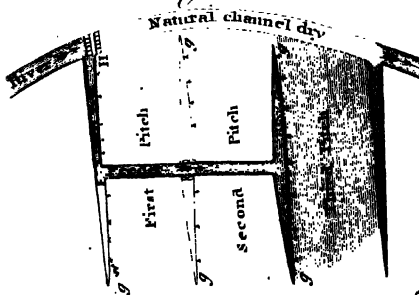


Fig. 5.



W. H. Kemp.

